Science Education

SCIENCE IN GENERAL EDUCATION

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A committee of the Progressive Education Association has stated the aims of general education as follows: "The purpose of general education is to meet the needs of individuals in the basic aspects of living in such a way as to promote the fullest possible realization of personal potentialities and the most effective participation in a democratic society." It is probable that this statement would be fairly acceptable to most of those interested in the field of general education. This college has been actively interested in the general education movement for more than four years, during which time we have been experimenting with this very important field of work. Most of the divisions of instruction have been busy studying the contribution which their respective fields might make to the program of general education. The Science Division was among the first to begin such a study in 1934. We have been studying and evaluating subject matter in the light of the objectives of general education in an effort to build a course of study that will make a maximum contribution in this field.

The first course presented in this division in the general education field was organized and taught by Dr. John Harty, then of our Physics Department. The following year, I reorganized the course and have been teaching it with increaing personal interest since that time. The objectives of science for the purposes of general education, as we conceive them, are:

1. To develop certain fundamental concepts which must form a basis for any rational interpretation of the phenomena of the world, and of man's relationship to such phenomena.
2. To acquire a working familiarity with the scientific vocabulary used in the literature which the average citizen may be called upon to interpret.
3. To learn something of the methods of scientific thinking by a study of the methods which leading scientists have used to solve various types of problematic situations.
4. To learn to appreciate the orderliness and beauty of the world by a study of the laws and principles that govern it.

It is the feeling of the Science Division of this college that science is prepared to make a very definite contribution to the democratic way of living. Max Otto has recently presented the broad concept of democracy in the following statement:

> "Democracy is not a mere association of individuals whose purposes or acts are individualistic in the *laissez faire* sense. It is not even primarily a form of government. It is an intelligent use of cooperative means for the progressive attainment of significant personalities. Significant personalities can not be unfolded from within; they must be acquired by individuals in the union with other individuals intent upon a similar quest."

Any field of knowledge that touches human life and activities in so many points as does science has a tremendous responsibility in connection with the development of modern life. There are few, if any, phases of human activity today that do not bear a very vital relationship to one or more of the fields of science. Industry today is dominated and controlled by chemistry and physics. It is becoming increasingly evident that our very life processes are determined by definite biological,

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chemical and physical principles. Health rests fundamentally upon our ability to keep certain chemical changes taking place in a normal manner and the body fluids in a normal state. It is more than ever clear that an understanding of certain important biological principles holds the secret of the future of the race. If man is to live intelligently upon the earth, understanding its nature and conserving its vast natural resources, it is important that he have some familiarity with the important geological laws and principles, the operation of which have brought the earth to its present state. One could hardly be said to have an adequate understanding of the earth without some knowledge of the other important celestial bodies that are, directly or indirectly, related to the earth.

With the foregoing ideas in mind, we have proceeded cautiously with the development of our course of study. There is a good deal of difference of opinion as to the best method of organizing such a course. Some colleges and universities plan a course in which each of the science fields is represented on the instructional staff in a brief series of lectures in which attempt is made to present the high points of the field. This method has some obvious advantages, among which is the fact that each field is represented by a subject matter specialist in that field. After due consideration, we have rejected this method on the ground that it is practically impossible to secure unity in such a course. Then, too, there is always the danger that some such specialist might want to take advantage of such an opportunity to propagandize his particular field. The narrowly trained subject-matter specialist is all too often unable to grasp the broad view of science. For him everything else is subordinate to his major interest. It would seem impossible ever to build on such a plan the course we have in mind.

There are some who have planned such a course to include a large number of relatively small units of each of the fields of science. We have rejected this plan because it gives only a brief smattering of the fields and no real abiding value would seem to accrue to the average student. I have made a brief study of one such course, and it seems that those planning the course have made a studied effort to bring into the course in miniature every fact and principle usually developed in a more comprehensive general course in each of the several fields of science. I consider a course of this type to be of very doubtful value, and not one that meets our concept of the survey course or our objectives. Some of these courses so planned are taught by several instructors, each prepared in his own field, while a few seem to be taught by one instructor who attempts to cover the entire field. I hardly see how such a course could be considered satisfactory in the light of what general education is trying to do.

The plan we have followed in this college is to select from each of the fields of physics, chemistry, astronomy, and geology, for example, a small number of large units around which the major concepts, laws and principles of the field can be woven. Thus, our first quarter's work is built around the following units:

I. The earth and its relationship to other heavenly bodies.
II. The nature of energy, its measurement, control, use, and transmission.
III. Man's use of electricity and magnetism.

In connection with the development of the first unit, an attempt is made to enable the student to see the earth as one body of a solar system; then as a member of a galaxy; and then as a very small part of an infinite universe of millions of galaxies. In the second unit, we endeavor to develop the idea that all forms of energy are simply different kinds of vibrations in different mediums. We try to lead the student to view all electromagnetic vibrations, from cosmic rays to the longest radio

waves, as similar in kind, but differing in frequency, and, hence, in properties. Sound is presented as being a particular kind of vibration in matter. Heat is shown to be molecules of matter in a state of motion. We feel that a degree of unity is obtained by this method that would be difficult, if not impossible, by other means.

In the third unit we develop the fundamental idea of magnetism, and the uses that man makes of it. From the idea of terrestrial magnetism, we develop the construction of lines of equal declination, and lines of equal inclination, showing the relationship of such lines to geography, surveying, navigation, *et cetera*. From the earth as a magnet we go to the production and use of permanent magnets, and then to electro magnets, and their many uses. The development of the principles of electric generators, motors, telegraph, telephone, radio, and the many other electrical instruments, and devices on the basis of the principles already developed is not difficult.

In our second quarter's work we organize the material presented around the following large units:

I. How the earth has come to its present state.
II. The laws that govern weather and climate.
III. How man secures an adequate and safe water supply.
IV. Chemistry contributing to man's progress.

The first of these units gives us an opportunity to develop the geological history of the earth, together with those forces that have brought the earth to its present state. This reaches back into the first quarter's work and ties up with the general picture of the formation of the solar system, and brings it down to the earth as we know it today, tracing it through its several geological stages of development, and studying the developing forms of life. This unit, like the first quarter's work, gives ample opportunity to tie up with and to enrich the fields of geography and the social studies. It is our plan to make conscious effort always to bring out every possible inter-relationship that would add comprehension and unity to the student's developing concept of the world.

In the unit of meteorology, we develop the laws and principles upon which the weather and climate are based. This gives opportunity to inter-relate this unit with certain physical principles of the first quarter's work, as well as with the field of geography, agriculture and commerce. In the third unit we attempt very briefly to bring out the methods by which modern man has endeavored to secure for himself a safe and adequate water supply regardless of where he may live. Special attention is given in this unit to the control of rural water supply, such as wells, springs, and cisterns. In the last unit of the second quarter, we attempt to give the student a brief overview of the tremendous contribution that chemistry has made to man's progress. A few important chemical principles are developed in an elementary way, such as, oxidation and reduction; the structure of matter; the nature of chemical and physical change; the characteristics of metals and non-metals; and the preparation and properties of a few important substances. Then the student is helped to see how these facts and principles have led man to the present-day comprehension of the structure and composition of the world in which he lives, and the inter-relation of the many different substances with which man has to deal.

The third quarter of our course deals with the field of biological sciences. We make no effort to parallel the general biology course, or the nature study course, which are given under separate title in the Biology Department. We start with man as a going concern, and then study the structure and function of the various parts of the human organism, their origin in earlier forms, and their development. A study is made of the various methods of reproduction in animal and plant forms, as well as of the essential facts of the developmental process by means of which

living forms have come to their present state. The units of this course are as follows:

I. How do living forms manage to maintain themselves, and survive?
II. How do the various forms of life reproduce their kind, and how are hereditary traits transmitted?
III. What are the mechanisms that control behavior in the various living forms?

In the first of these comprehensive units we endeavor to trace the development of bodily structures in a very elementary way from the simple cell to the infinitely complex human organism. In the second unit we endeavor to understand the methods of reproduction of various forms of plant and animal life, from the simplest cell division of unicellular forms to the infinitely complex process of human reproduction. We endeavor also to trace the operation of the laws of heredity, as well as the essential facts of evolution. In the third unit of this quarter we attempt to study the developing methods of response to stimuli on the part of various forms, leading to the problems and mechanics of human behavior.

It is quite obvious that the brief time allotted to this phase of our work necessitates the omission of much that one would like to include, but it is felt that the main essentials can be developed under each unit. The chief aim of the quarter's work is a better understanding of the human body and the development and functioning of its various parts, and the maintenance of the human mechanism in normal working order.

It is our feeling that this survey course gives to each student, regardless of his previous experience in the fields of science, an opportunity to explore the various science fields briefly. It helps the student to view science, not as a series of unrelated fields, but as different aspects of one vast system with no fixed boundaries between the various fields, but with many interrelations. On such a foundation a student can build his work in the special sciences with more intelligence. Many who have no special interest in the field of science acquire an overview of the field that enables them to have a reasonable comprehension of the place of science in the world of affairs. Some who have had no previous experience in the science field find themselves for the first time in this course, and elect to pursue further work in one or more fields of science to the development of a major or a minor, though no effort is made to "sell" any student on any field of science. It gives a maximum of unity, and, we feel, throws a considerable light on many other fields of human activity.

The greatest difficulty which we have experienced in this course is in finding a teacher who is sufficiently versatile in the various science fields to develop and teach such a course. Your present speaker admits his own inadequacy in this regard. Although he is neither a physicist, an astronomer, a geologist or a biologist, he is making a serious endeavor to develop and present a course that is worthy of the lofty objectives of general education, and that will be a real contribution to the curriculum. He has yet to hear any one refer to it as a "snap course," while many have elaborated at length on certain difficulties which were experienced. It is felt that most of the students who have taken the course have found it both interesting and worthwhile. We are still experimenting. We are not satisfied with what we have yet, but we believe we are working in the right direction. We shall welcome all possible constructive criticism, and any help we can get.

RADIO AS AN AID TO INSTRUCTION IN ELEMENTARY SCIENCE

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In the spring of 1938 the Board of Education of the City of New York under the auspices of the New York Principals' Association presented fifteen broadcasts over Station WNYC for use in elementary schools of the city. Three series, Literature, Nature, and History, consisting of five broadcasts each, were presented. The broadcasts were fifteen-minute dramatizations by elementary school children and were presented on Fridays at 11:00 A.M. In order that a better understanding might be obtained of the educational effectiveness of these radio programs, the writer undertook a brief investigation of the Nature Series of the broadcasts.

The five Nature Series programs were entitled, in order of their presentation, "Children of the Woods," "A Trip to Birdland," "Rocks of Our Neighborhood," "Wonders of the Evening Sky" and "An Adventure with a Spider." Using the radio scripts as guides, two test forms, Form A and Form B, each entitled *Questionnaire and Test*, were prepared. Form A was given to pupils who had heard the broadcasts while Form B, serving as a control to Form A, was given to pupils who had not heard the broadcasts. Responses to Form A were received from 795 pupils in 25 classes to which all five broadcasts had been presented. Responses to Form B were received from 859 pupils in 27 classes who had heard none of the broadcasts. Responses from 369 pupils in 11 classes, who had heard some of the broadcasts but not all of them, were not considered in this study. All the pupils were in the fifth grade and were in schools scattered more or less at random over the five boroughs of New York City.

Items 1 to 5 of the *Questionnaire and Test* concerned the use of the radio itself. Of the pupils in the experimental group 60 per cent indicated that they understood clearly what was said during the broadcasts. About 99 per cent indicated that they had radios in their homes. About 15 per cent of the pupils indicated that one or both parents had listened to at least one of the broadcasts. In the control group over 99 per cent said that they liked to listen to the radio; 82 per cent believed a radio would be a useful thing to have in the classroom; and 95 per cent said that they would have liked to have listened to the Nature Series broadcasts. About 98 per cent said that there were radios in their homes. Over 60 per cent believed that their parents would have liked to have listened to the Nature Series broadcasts.

Items 6 to 40 were identical on the two test forms. Items 6 to 15 had to do with activities to which pupils might have been stimulated as a result of the broadcasts. These questions and responses to them in terms of percentages are given in Table I. The last column, t,[1] gives some indication

[1] By definition $t=\dfrac{p_1-p_2}{\sqrt{p_1-p_2}}$ where

p_1=percentage of experimental group giving favorable response

p_2=percentage of control group giving favorable response

$\sqrt{p_1-p_2}$ =standard error of the difference between p_1 and p_2

To determine $\sqrt{p_1-p_2}$ let

N_1=total number of responses by experimental group

N_2=total number of responses by control group

n_1=number of favorable responses by experimental group

n_2=number of favorable responses by control group

Then $p_1=\dfrac{n_1}{N_1}$ and $p_2=\dfrac{n_2}{N_2}$.

In the hypothesis which is to be tested it will be assumed that both the experimental and control groups are samples of the same population, or, in other words, that there are no real differences

of the reliabilities of the differences between the responses of the experimental and control groups. For purposes of this discussion it is assumed that, if t exceeds 2.6 in absolute value, the differences are reliable.[2]

An examination of Table I reveals that the experimental group on nine out of the ten items indicated a greater amount of activity than did the control group. On eight out of these nine items the differences were highly reliable. It seems safe to conclude, therefore, that radio programs do serve as a definite stimulus to further activity.

Items 19 to 33 inclusive were true-false questions on information. About two-thirds of these questions were based upon information actually given in the script while the other one-third had to do with ideas which might have resulted from further discussion or reading. The questions with their results are shown in Table II. It is seen that the experimental group did better on eight items while the control group did better on seven. On six of the eight items favoring the experimental group the differences are reliable while only in two cases are the differences favoring the control group reliable. The results here are not so impressive as in the previous case, but do indicate that some information was gained either directly from the broadcasts or because of the stimulus they provided.

Items 16 to 18 and 34 to 40 deal in part with attitudes and in part with concepts which, while not actually mentioned in the broadcasts, might have been influenced as a result of the broadcasts. These items with their accepted answers and the responses to them are shown in Table III. Taking the results as a whole, the experimental group again shows superiority. The experimental group ranks higher on six items, the control group on three, with one item showing no difference. Four of the six differences favoring the experimental group are reliable and two of the three favoring the control group are reliable.

While on the whole the responses to the items favor the experimental group, numerous exceptions on particular items have been noted. The attempt was made, therefore, to find other general tendencies appearing in the results. A study by programs indicates that "Rocks of Our Neighborhood" was not received as well as were the other broadcasts. With respect to activities the items concerning this program were the only ones which failed to yield significantly higher results for the experimental group. In information the control group scored considerably higher

distinguishing the two groups. This would mean that the observed differences between the two groups were due to errors of sampling. On the basis of this assumption the best estimates of the standard errors of p_1 and p_2 for the two samples are given by

$$\sqrt{p_1} = \sqrt{\frac{p_0 q_0}{N_1}} \quad \text{and} \quad \sqrt{p_2} = \sqrt{\frac{p_0 q_0}{N_2}}$$

where

$$p_0 = \frac{n_1 + n_3}{N_1 + N_2} \text{ and } q_0 = 1 - p_0.$$

The standard error of the difference between two percentages is given by:

$$\sqrt{p_1 - p_2} = \sqrt{\sqrt{p_1}^2 + \sqrt{p_2}^2}\ .$$

or, finally

$$\sqrt{p_1 - p_2} = \sqrt{\frac{n_1 + n_2}{N_1 + N_2}\left[\frac{N_1 + N_2 - (n_1 + n_2)}{N_1 N_2}\right]}$$

[2] The reasons for this are as follows. We first assume the hypothesis that p_1 and p_2 are not reliably different, their observed differences being due to errors of sampling. In order to test this hypothesis we calculate t. An examination of the distribution curve for t reveals that 99 per cent of all its values are less than 2.6 in absolute magnitude. Therefore, if the value which we obtained for t is greater than 2.6 we feel justified in rejecting the hypothesis that p_1 and p_2 are not reliably different. Or, stated positively, if t is greater than 2.6 we feel justified in assuming that there is a reliable difference between p_1 and p_2. A value of t less than 2.6 does not necessarily mean that this difference is not a reliable one: it indicates merely that conclusions cannot be drawn from the information available.

For a more complete discussion see Snedecor, George W., *Statistical Methods.* 1938. Ames, Iowa: Collegiate Press, Inc., pp. 56–59.

than did the experimental group. "Woods" and "Spiders," on the other hand, yield no results which favor the control group by reliable differences. "Birds" and "Stars" each have one item on which the control group scored higher by a reliable difference. As the number of items having to do with "Rocks of Our Neighborhood" was not large, it would hardly be proper to attempt to state why this broadcast was

TABLE I—ACTIVITIES*

COMPARISONS BETWEEN EXPERIMENTAL AND CONTROL GROUPS ON ACTIVITIES TO WHICH CHILDREN IN THE EXPERIMENTAL GROUP MIGHT HAVE BEEN STIMULATED AS A RESULT OF THE BROADCASTS

Item	Accepted Response	% Correct		p_1-p_2	$\sqrt{p_1-p_2}$	$t=\frac{p_1-p_2}{\sqrt{p_1-p_2}}$
		Experimental p_1	Control p_2			
WOODS						
6. During the past few weeks have you done any reading about flowers in books or magazines?	Yes	65	35	30	2.5	12.3
7. Have you been out in the country to the woods, to the botanical gardens, or to some of the parks this spring to look for flowers?	Yes	70	55	15	2.4	6.4
BIRDS						
8. Have you looked in books or magazines during the last few weeks to learn the names of birds that you didn't know before?	Yes	48	33	15	2.4	6.4
9. Have you been trying during the last few weeks to watch the activities of birds?	Yes	64	55	9	2.4	3.6
ROCKS						
10. Have you been recently to the Museum of Natural History to see the rock and mineral collections there?	Yes	33	33	0	2.1	0.0
11. Have you had an opportunity to watch men dig or blast lately and to see the rocks that they uncovered?	Yes	47	43	4	2.5	1.7
STARS						
12. Have you tried any time recently to locate star constellations?	Yes	63	40	23	2.5	9.2
13. Have you been reading during the last few weeks stories about stars and star constellations?	Yes	48	20	28	2.3	12.0
SPIDERS						
14. Have you tried to find out more about spiders during the last week or so?	Yes	46	21	25	2.1	11.7
15. Have you examined closely any spiders or their webs during the last few days?	Yes	38	25	13	2.3	5.7

* The number of responses to each item used in preparing this Table varied between 796 and 786 for the experimental group and between 861 and 851 for the control group. Three figures were used in all calculations but the last figure was rounded off when this Table was constructed.

less well received than were the others. However, it should be emphasized that the results do not mean that geological materials are less suitable for radio broadcasting than are materials from other areas of science.

One source of inconsistency in the results undoubtedly was in the selection and statement of the items themselves. The limited time available for the construction of the tests made it impossible to establish the validity of each item. Several bad items may be noted. Question 25, while specifically based upon a passage in the script, probably was confusing to many pupils. Question 26, while simple and unambiguous, probably was not suited to the level of the pupils taking the test. Questions 34, 36, and 37 are all "double-jointed" and therefore probably were confusing to pupils. The items just mentioned were given to determine what effects the personification of Mother Nature and plants and animals in the broadcasts had on children. On the basis of the results obtained, this question still remains unanswered.

In order to obtain additional information, criticism, and suggestions concerning the broadcasts two questionnaires for teachers, Form C and Form D, were prepared. Form C was sent to teachers who, with their classes, had heard the broadcasts. Form D was sent to teachers who had not heard the broadcasts and whose classes had not heard them. Analysis was made on 72 responses to Form C and 68 responses to Form D. As the questions called for long written statements as well as for short *Yes* and *No* answers, complete results cannot be given here. Their chief value, of course, lies in the criticisms and suggestions which may be used in planning future broadcasts.

On items which are comparable, Form C substantiates the results obtained from Forms A and B. Over 80 per cent of those responding to Form C indicated that the broadcasts were effective in stimulating interest for further study. Also, "Rocks of Our Neighborhood," the only broadcast on which the experimental group showed no superiority over the control group, was liked least by the teachers.

From other parts of Form C it was found that two-thirds of the teachers favored experimentation with methods of presentation other than, or in addition to, dramatizations by school children. About 97 per cent found the preliminary suggestions helpful, but many felt that these suggestions should contain more on visual aids.

Of the teachers responding to Form D, 20 per cent said that radios were available for their classes while 86 per cent believed that radios should be made available. The radio was believed to have possibilities as a method of instruction by 90 per cent and 71 per cent felt that it would have been desirable for their classes to have heard the Nature Series. Nearly 33 per cent believed that a different set of topics should be attempted, and 44 per cent believed that a different method of presentation would be more fruitful. It was felt by 54 per cent that fifteen-minute broadcasts once a week were sufficient while 44 per cent felt that more time would be better and 2 per cent felt that less time would be better. Half the teachers believed that parents would be interested in the broadcasts.

On the basis of this study the writer feels the following conclusions and recommendations justified:

I. Conclusions:

It has been shown that radio broadcasting can be a usable educational device: (1) particularly for stimulating further activity on the part of children, (2) as a means of transmitting information, and (3) in affecting attitudes.

II. Recommendations:

If this series of broadcasts is to be continued in New York City, plans should be made for: (1) improving receptions, (2) improving broadcasts both in content and methods of presentation, and (3) providing teachers with additional materials including suggestions for visual aids to be used in connection with the radio programs.

TABLE II—INFORMATION *

COMPARISONS BETWEEN EXPERIMENTAL AND CONTROL GROUPS ON INFORMATION WHICH CHILDREN IN THE EXPERIMENTAL GROUP MIGHT HAVE GAINED FROM THE BROADCASTS OR FROM STUDY IMMEDIATELY FOLLOWING THE BROADCASTS

Item	Accepted Response	% Correct		p_1-p_2	$\sqrt{p_1-p_2}$	t
		Experimental p_1	Control p_2			
WOODS						
19. When the ground is cold, flowers are not likely to start growing.	True	78	79	—1	2.0	—0.3
20. Certain kinds of flowers which grew in large numbers hundreds of years ago are almost gone now.	True	67	69	—2	2.3	—1.0
21. In this section of this country flowers are found in the woods as early as March 1st, April 1st.	March 1st	43	28	15	2.4	6.3
BIRDS						
22. Robins change color during certain portions of the year.	True	78	75	3	2.1	1.5
23. The Blue Jay is really red in color.	False	95	87	8	1.4	5.6
24. Most of the things a robin has to do, such as preparing his food, shaping his nest, and feeding his young, he does with his feet.	False	76	73	3	2.1	1.6
ROCKS						
25. In New York City rocks of the same kind are always found within one or two blocks of one another.	False	44	54	—10	2.5	—4.1
26. Quartz is a rock.	False	19	36	—17	2.2	—7.6
27. People who study rock and rock formations are called geologists.	True	90	74	16	1.9	8.0
STARS						
28. On a clear night more than a hundred thousand stars are visible even without a telescope or field glasses.	False	14	19	—5	1.8	—2.4
29. The Big Dipper is always in the northern part of the sky.	True	78	68	10	2.2	4.4
30. If a sailor knows where the North Star is he can also locate the other directions; south, east, and west.	True	96	92	4	1.1	3.1
SPIDERS						
31. The bite of all spiders is very poisonous.	False	88	79	9	1.8	4.9
32. There are about a hundred different kinds of spiders in the United States.	False	18	19	—1	1.9	—0.4
33. Spiders sometimes eat other spiders.	True	80	82	—2	1.9	—0.9

* The number of responses to each item used in preparing this table varied between 795 and 780 for the experimental group and between 861 and 823 for the control group. Three figures were used in all calculations.

TABLE III—ATTITUDES*

COMPARISONS BETWEEN EXPERIMENTAL AND CONTROL GROUPS ON ATTITUDES OR CONCEPTS OF NATURE WHICH MIGHT HAVE BEEN INFLUENCED AS A RESULT OF THE BROADCASTS

Item	Accepted Response	% Correct		p_1-p_2	$\sqrt{p_1-p_2}$	t
		Experimental p_1	Control p_2			
16. Do you think it would be worth while to learn something about the rocks in your neighborhood and find out what their names are?	Yes	96	93	3	1.1	2.4
17. Do you think it would be fun to make a mineral collection?	Yes	95	95	0	1.1	0.0
18. Do you think that looking at stars is a waste of time?	No	95	89	6	1.3	4.2
34. We sometimes speak of "Mother Nature," but as a person she does not exist.	True	88	78	10	1.8	5.3
35. Flowers in the woods are things of beauty and therefore should be protected.	True	99	96	3	0.84	3.3
36. Birds probably talk about as many different things as we do, only we do not understand them.	False	4	5	—1	1.0	—0.9
37. The woodpecker eats bugs and insects because the bugs and insects are destroying trees.	False	40	46	—6	2.4	—2.6
38. The constellation "Great Bear" was really at one time a bear which wandered through the woods.	False	64	70	—6	2.3	—2.6
39. Because spiders kill flies and other insects they should be protected.	True	66	33	33	2.5	13.3
40. Spiders live without caring what farmers or other people think about them.	True	90	87	3	1.6	1.8

* The number of responses to each item used in preparing this table varied between 796 and 790 for the experimental group and between 861 and 830 for the control group. Three figures were used in all calculations.

A PROJECT IN PURPOSEFUL READING IN BIOLOGY

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There are many objectives for Secondary Education but none is any more important than developing the habit of reading. When, over two years ago, an otherwise bright pupil told his teacher that he did not care to read a suggested book because he felt that his textbook was all that he needed, the teacher felt that something could be done to stimulate the desire to pursue new avenues that would be profitable.

Certainly, the one thing that stands between having a subject like biology a dead

issue, once its formal study is over, and having it a continuing and absorbing interest throughout life is the habit of purposeful reading around the various topics hinted at in a general high-school course. Too often, pupils get the idea that the text is the "be-all" and "end-all" of study. How much better it would be if all pupils understood that each paragraph of the text or even many sentences could be, and have been, expanded into whole texts, university courses, or perhaps life-time pursuits?

To encourage reading, there have been many artifices employed, ranging all the way from forms of coercion, such as threatened failure if a certain number of book reports are not in to voluntary reading for extra credit. Undoubtedly, each teacher has his own proved methods that apply to his own teaching philosophy and pupil type. It would seem, however, that the kind of enterprise suggested here should be largely voluntary in order to create the taste for reading such material. By placing reading matter in the path of students, the teacher often opens an avenue which proves the "way of light" for otherwise intellectually indifferent students.

An attempt was made at Brookline High School to broaden the scientific interest of students through the medium of greater use of library facilities. The results so far have been gratifying. With the aid of the librarian, a tentative book list was formulated. On a purely voluntary basis, pupils were asked to read from the list and report on a form which was intentionally simplified. This form merely asked for the title and a simple statement of the book's content and whether or not the pupil would

Author.....................................
Last First
Title..
Publisher.......... Date of Publication........
(BE ACCURATE AND PRINT THE ABOVE)

In general, with what does this book deal?

Would you recommend this book to be added to our reading list? Why?

SECTION DATE NAME

recommend it to be retained on the list. Because the whole project was set up as a sort of research enterprise, wholehearted cooperation was given. It was in the compilation of the list that the educational value of the project lay. The general purpose was to get children to read more, thus the objective was realized in the formation of the list. In the future the incentive might very well be the revision of the list to meet differing taste and the addition of new titles.

Certainly the teacher should be familiar with a large number of the books that are offered to students to read. There are many lists for student reading available, especially in textbooks or in books dealing with the teaching of science. Most of these lists contain almost exclusively books which are more or less technical or which expand specific topics taken up in a given chapter of the text. There is a need for a list which could be classed under the broad heading of "literature," consisting of such minor headings as fiction, scientific exploration, nature poetry, animal stories, essays, and even plays. In such reading matter, there is a wealth of scientific application which, through its presentation, comes more closely to the personal experiences of the student than does the reading of fact upon fact in some text.

It may be argued that one would have to read a host of such books in order to cover much of the field of biology. This is true. Yet if one looks upon the biology course as a survey course and remembers that pupils have varied interests, it is possible to develop a good list of books that will offer an opportunity for all students to progress far in any selected field.

Serious teachers of science are realizing more and more that their one particular subject cannot be segregated from the other fields of scientific study. Reading Beebe, for example, suggests to the pupil that in order to photograph fish or to bring them to the surface, there are many other sciences involved besides biology. Thus

he ties up his biology with the principles of physics, mechanics, chemistry, and navigation.

Practically no limit was set on what could be read either within or without the tentative list. The only criterion was that the book must have some connection with biology. If it were a novel, it must have had a biological setting as may be found in *Green Mansions* or *Red Rust;* if it were travel, it must have dealt primarily with scientific exploration, such as the books of Andrews or Buck. Essays included those of Burroughs and Grayson; biographies of biologists were numerous and fascinating. Realizing that in any group there is a wide range in tastes and reading ability, the teacher gave latitude in developing a desire for good literature through trial, error, and comparison rather than by forcing a child to read something which he had been told was good, but did not know why it was good.

Over a period of two years, a list of over five hundred titles were read, many of them a score of times. Taking into consideration the pupil's reactions as stated on the forms, the number of times read, and other criteria suggested by the teachers and the librarian, a more or less permanent list was devised. Many titles were deleted and some added. All were classified under appropriate headings and the completed and revised list sent to the printing department to be attractively reproduced. From year to year as new books appear or as an apathy suggests itself toward any titles, changes can be introduced.

There was a definite preference for books of adventure among the boys. These included books about biologists who adventured in out-of-the-way places or about those who had experiences with animals at home or abroad. It was interesting to note that there was always a large demand during any reading period for those books which had been emphasized in the period preceding. Girls liked novels with agricultural backgrounds and to a lesser degree biographies and nature essays. The many books dealing with the life and works of doctors were most popular among the biographical material. Philosophical essays and technical books dealing with plants, insects, and the microscope had the lesser appeal.

To make any such project as this a vital thing was not left to chance. Merely to put the list in the hands of students did not suffice. First, it was decided how many books for outside reading a pupil can be honestly asked to read as a minimum. For some, one book a quarter was the limit; others read as many as four books a month. Second, a "library period" was undertaken at the beginning of the year when each class was taken to the library or a library truck load of books was brought to the class room. Selections were made at that time and an opportunity given to be introduced to a book. Similarly, at the beginning of each previously determined monthly or quarterly reading period the class was given a start. Thus, the usual accepted pressure of having to return a book to the library within a given time served to promote continued application to the reading. Third, cooperation with the teachers of English, remedial reading, *et cetera,* helped to impress upon the minds of the pupils the importance of their reading adventures. Credit, encouragement, and opportunities to use the results of their increased reading made students more eager to go ahead.

It was pleasant to have the outcomes of this reading enterprise project themselves into class discussions. As the reading adventure progressed many students who heretofore had sat idly by during a preview of a unit contributed to the general background of the class. New pupil interests were thus seized upon and enlarged. There was further evidence of the value of encouraging reading in the activity periods when students volunteered information gained from a book recently read.

ELECTRIC CIRCUITS

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A worth-while group of activities may be developed around the construction and operation of simple electric circuits in which flashlight cells and bulbs are used. I find many a college senior who is unable to connect a dry cell and flashlight bulb in such a way as to get results. Some try to connect wires without removing the insulation. Others arrange some sort of a "one-way" circuit and expect it to work. Yet the idea of a complete circuit is so simple that first-grade children easily learn to join dry cells and flashlight bulbs in such a circuit. The skills acquired may be employed in a variety of ways; e.g., for lighting marionette theaters or other types of toy theater, for making model lamps for use in toy homes or in models of cities, and for setting up experiments in connection with other science units. Such understandings as are developed through work with simple circuits may form the basis for further work dealing with production and use of power, electricity in the home, communication devices such as telegraph, telephone, radio, and so on.

Assuming that there has been developed a need, at about second or third-grade level, for a study of electric circuits, the first step is to arrive at an understanding of the things necessary for a complete operating circuit. These are: (1) a source of supply of current, (2) a switch for controlling the circuit, (3) something to be operated by the current, and (4) connecting wires. Members of the class will be able to bring in flashlight cells and bulbs, wire, binding posts from old dry cells, etc. Such materials are easily procurable and inexpensive. Through examination of flashlights and household electrical appliances, it may be brought out that each has two points of contact. A light bulb may be examined and the two points of contact pointed out. Light sockets may be examined to show how the two wires of the lighting circuit are made to come in contact with the two points of contact in the bulb. The fact may be noted that the plug for connecting household appliances always has two prongs. An examination of these appliances, and also of battery-operated devices such as flashlights and bells, may be made to locate the switch. A discussion may then be carried on to make the point that electricity is a flow of tiny particles called "electrons" through a circuit, and that this flow of current must make a complete circuit of the path in order to operate any electrical device. Thus the current is led from the source through one wire, through the device to be operated, and then back to the source through another wire. Further discussion will show how the switch is a way of breaking this complete path of circuit, thus stopping the flow of electrons. I find it easier to talk with children about electricity as a flow of very tiny particles called "electrons" than to leave it as some nebulous, undefinable something which electricians often speak of as "juice."

We are now ready to attempt to construct a simple circuit using a dry cell and flashlight bulb. Although small porcelain sockets and various types of simple switches may be purchased, I feel that there is an advantage in having children devise and construct their own. If the general idea is made clear to them, they will often invent ingenious variations. A simple switch may be made from a strip of springy metal such as brass or tinned

iron from a tin can with a half a spool for a handle (Fig. 1*a*). The simplest switch I have seen was invented by one of my students. The switch consisted of a thumbtack and a two-inch strip of metal bent up at one end (Fig. 1*b*). Sometimes

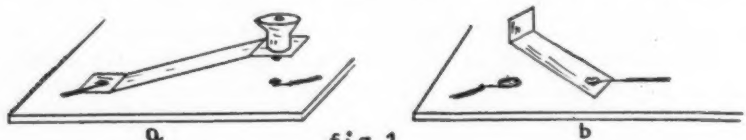

fig 1

children will bring in an ordinary house-lighting switch of the old-fashioned rotary button type, or a push button, and wire it into the circuit. A very simple light socket may be made by running two wires through a small wooden block, and coiling one wire into a spiral by winding it around a flashlight bulb. The bulb may then be screwed and unscrewed into this spiral just as an ordinary light bulb is screwed into its socket. The other wire is fastened around a tack upon which the base of the bulb rests (Fig. 2*a*). Such a socket may be mounted on a post to serve as a street light in a model village, or it may be hung from wires, fitted with a paper shade, and made to serve as a bridge lamp or other type of lighting fixture in a model home. A good project could be developed to show the difference between indirect and direct lighting, for example. In working with simple circuits it is not even necessary to use a block to hold the wires. If stiff bell wire is used to make the spiral, it will be sufficiently rigid in itself to support the bulb (Fig. 2*b*). The simplest such socket I have seen was again an invention of one of my students (Fig. 2*c*). Although simple to make, it has the disadvantage that the bulb cannot easily be removed and replaced.

Now we have a source of current (flashlight cell), a switch, and a device to be operated (flashlight bulb and socket). The next thing is to combine them into a working circuit. Provide a suitably sized board for the base. Some sort of support must be provided to hold the dry cell, assuming that it is to be one of the flashlight variety. Two pieces of stiff metal bent to form right-angle supports may be made, or small angle irons purchased for a few cents may be used. It is desirable, in order to carry on the future work, to have some supports constructed to carry one cell, and some constructed to carry two or even three cells (Fig. 3). Most flashlights now made are designed to operate on two cells. Bulbs for such flashlights are usually marked 2.3 to 2.6 volts. If only one cell is used, a bulb marked 1.25 volts should be obtained. A bulb marked 6 volts or 4–6 volts requires four cells to light it to proper brilliance. The 1.25-volt bulbs are sometimes hard to find, but larger five-and-ten-

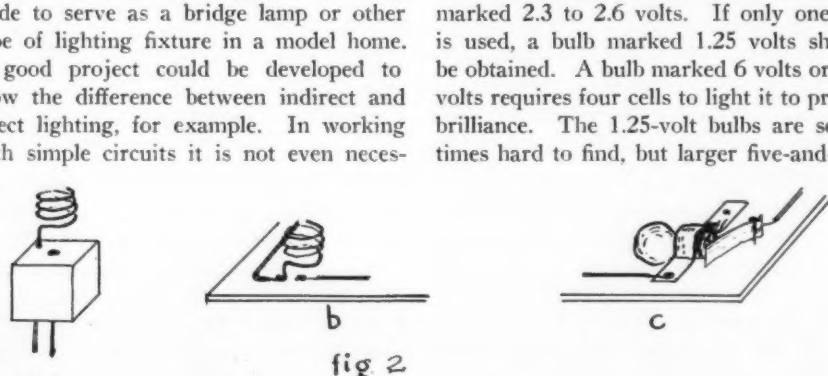

fig 2

cent stores and radio-repair stores usually carry them. Old dry cells of the cylinder type or the new Burgess "little six" type may be utilized advantageously to furnish binding posts. If such old cells are not

available, binding posts of various types may be purchased for very little at radio-repair shops, or may be constructed from small bolts and nuts. The wires may even simply be fastened under the heads of screws used to fasten the parts of the cir-

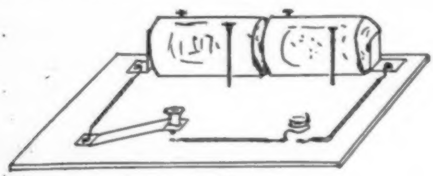

fig. 3

cuit to the board. The use of binding posts produces a neater looking and more flexible piece of apparatus. I have had students set up a circuit of from two to four cells so arranged with binding posts that any desired number of the cells could be used in the circuit.

After the above work is carried out, the following meanings should have become more or less a part of each individual's thinking. These ideas are expressed here in adult, not juvenile, language.

1. An electric current will not flow unless there is a complete path from the source of current through the device to be operated, and back to the source again. Such a path for the flow of electricity is called an "electric circuit."

2. An open circuit is one in which there is at some point a break through which the electrons cannot flow.

3. A closed circuit is one in which there are no breaks and the electrons may therefore flow through the circuit and operate whatever device is being used.

4 A switch is a device for opening and closing the circuit. There are various types; e.g., a key switch, a knife switch, a push button, and a snap switch.

5. An electric current is assumed to be a flow of tiny particles called electrons over a conductor. (Notice that the word "over" rather than "through" is used. The use of "over" is intentional, but the reasons for this choice are too technical to warrant discussion here.)

The work up to this point may be carried on in the first three grades in a variety of ways.[1] Let us now consider how such circuits may be used in the intermediate and upper grades as an aid in making more meaningful some other ideas regarding the use of electricity in the home. The purpose of this next set of activities is to make meaningful the ideas of volt, ampere, ohm, and watt as units of measure of electricity, and to show the relationships of these units in the operation of some common electrical devices.

We will assume that we have several of the circuits described above, some with one cell, some with two, and some using 1.25-volt, some using 2.3-volt, and some using 6-volt bulbs. An immediate difference in the brightness of the bulbs will be noticed. The 1.25-volt bulb on one cell seems to be about as bright as the 2.3-volt bulb on two cells. The 1.25-volt bulb on two cells burns very brilliantly, obviously much more brightly than it should, and it should not be left long on such a circuit as its life would be short. It may even be worth while to overload a 1.25-volt bulb or a 2.3-volt bulb by adding more and more cells until it burns out.

It is an advantage at this point to have a voltmeter and ammeter available. However, as most elementary schools are not yet so equipped, I shall develop the next step as I would without such instruments. The class must be told that the brightness of the bulb is a rough measure of the current flowing through it, and that current is measured in amperes. The 2.3-volt bulb on two cells and the 1.25-volt bulb on one cell appeared equally bright. Therefore they must be drawing about the same current. A flashlight bulb is so designed that it will be at proper brightness when, roughly, a current of .3 ampere is flowing through it. "Current" is the rate of flow of electrons. The number of cells then must be a measure of the "push" required to "push" the electrons along the wire and through the bulb. The class may now be told that one cell gives a "push" to the electrons of about 1.5 volts. As the cells are connected in series, each additional cell

[1] See, for example: Myra E. Foster, "First Grade Physical Science," *NCES News Notes* (March, 1937).

gives an additional 1.5 volts of electrical "push" or pressure. This "electrical push" is usually spoken of as "voltage" or "e.m.f." The latter term stands for electromotive force. When we speak of voltage, then, we mean the amount of push acting to force electrons over the circuit. Let us now observe a 1.25-volt bulb, a 2.3-volt bulb, and a 6-volt bulb, each operated by two flashlight cells in series. The 1.25-volt bulb is too bright, the 2.3-volt bulb is about right, and the 6-volt bulb is much too dim. Evidently 3 volts of electrical push pushes too many electrons through the 1.25-volt bulb and not enough through the 6-volt bulb, but evidently pushes the right amount through the 2.5-volt bulb, which is designed to operate properly on two cells. What, then, is the difference in these bulbs? Evidently the voltage marked on them is merely an indication of the approximate voltage at which they work properly.

Evidently the difference in these bulbs is a difference in the opposition which they offer to having electrons pushed through them. This is a difference in resistance. The 1.25-volt bulb has the lowest resistance. One cell, or 1.5 volts, is enough to force .3 ampere of current through to light it to proper brilliancy. The 2.3-volt bulb has about twice as much resistance. One cell (1.5 volts) will only push about .15 ampere through it, not enough to light it to proper brilliancy. Two cells, or 3 volts, however, will push the necessary .3 ampere through the circuit to make the bulb shine with proper brightness. The two cells will only push about .1 ampere through the 6-volt bulb—not nearly enough. Its resistance is over twice that of the 2.3-volt bulb. By using four cells, or 6 volts, we find we can push the necessary .3 ampere through the 6-volt bulb to make it glow properly.

We now have the relationship between three units of electrical measurement: (1) the volt, which is a measure of electrical pressure or "push," (2) the ampere, which is a measure of current, or rate of flow of electrons, and (3) the ohm, which is a measure of resistance, or opposition to the flow of electrons. A given electrical device is designed by making it of the proper resistance to allow the proper current to flow through it at the voltage on which it is intended to be used.

This same approach may be made through a study of lamps in the ordinary lighting circuit. I do this with our college students preparing to teach in the elementary school, but voltmeters and ammeters are required to develop this phase properly. After having reached this point in discussing these dry-cell circuits, I often ask whether the class thinks a 40-watt lamp will draw more or the same current as the flashlight cell. Usually the consensus of opinion is that it will draw much more, and they are surprised to find that such a bulb draws only about .3 ampere. A bulb designed to give more light but to be operated on a 120-volt house circuit must have more current in order to heat up more wire to the glowing point. Thus it must have less resistance in order that the 120 volts of "push" will send enough current through it. But even a 150-watt bulb draws only about an ampere of current.

The class may now be g iven the mathematical relationship between these three units if the members are sufficiently advanced to be able to do long division. The current in a circuit is equal to the voltage divided by the resistance. This furnishes an excellent opportunity to develop the quantitative concepts of direct and inverse proportion. Of course they do not have to be taught under these names and as formal mathematical processes, but rather the feel for these two types of relationships should be given. Once this is attained it is relatively simple to teach the mathematical way of expressing these concepts. If the voltage increases, what happens to the current? If the resistance increases, what happens to the current? More push sends more electrons through. More resistance

prevents electrons from being pushed through. At this point, assuming that one cell (1.5 volts), two cells (3 volts), and four cells (6 volts) will push .3 ampere through the 1.25-volt, 2.3-volt, and 6-volt bulbs respectively, the resistance of each of these bulbs may be calculated. Resistance equals voltage divided by the current. The voltage of the source used, not that marked on the bulb, of course, should be used in such calculations. It is instructive to have the class take apart an old radio "B" battery, designed to give 22½ or 45 volts, and count the number of small dry cells which make it up. If the "little six" Burgess dry cell is taken apart, it will be found to consist of four separate cells. These are connected in parallel, however, rather than in series, so the voltage of the whole dry cell (really a dry cell *battery*) is the same as that of one single cell. The older cylinder type is a single large cell. The flashlight batteries of the flat type, when taken apart, will be found to consist usually of two cells in series, thus giving 3 volts.

The idea of resistance may be further developed by constructing a small variable resistance and inserting it in the circuit. Such a variable resistance, sometimes

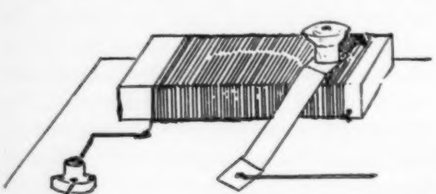

fig 4

called a "rheostat," may be made by winding thirty or forty turns of copper wire around an oblong block of wood and arranging a rotating switch to slide over the wires (Fig. 4). If insulated wire is used, the insulation must be scraped off under the place where the switch arm will make contact. Another simple way to construct such a device is to prepare about six or eight spirals of fine copper wire and arrange them with thumbtacks for contact points so that by means of a rotating key switch the cells may be added to the circuit one at a time. A small variable rheostat is used to control the volume in radios and may be purchased at a radio store. With any one of these devices it may be shown that the light dims as additional resistance is added into the circuit.

After these activities have been carried out and studied, the following additional meanings should have been developed:

1. The source of electricity furnishes the push which drives electrons over a circuit. When chemical cells are the source, each cell furnishes about 1.5 volts.
2. An electrical device offers resistance to having electrons pushed through it. The electrons in overcoming this resistance do work and operate the device. In the case of a lamp, the electrons, in overcoming the resistance, produce heat which heats the wire sufficiently to cause it to glow brightly. The unit of measure of resistance is called the "ohm."
3. The rate of flow of electrons along a circuit is a measure of the current flowing in the circuit. The unit of measure is the ampere.
4. Increased voltage will cause a greater current to flow through a circuit of given resistance.
5. A low resistance will allow more current to flow through a circuit at a given voltage than a high resistance.
6. One volt will push a current of one ampere through a resistance of one ohm.
7. The current used by an ordinary flashlight bulb is about .3 of an ampere.
8. A flashlight bulb designed to operate two cells will have a resistance of about 10 ohms.

Class discussion may bring out further facts about the usual values for electric units, such as: A storage cell produces about 2 volts; hence a storage battery of three cells such as is used in automobiles produces about 6 volts. The house lighting circuit is usually supplied at from 110 to 120 volts. Users of electric stoves usually have them on separate circuits at about 220 volts. A 40-watt lamp draws a little of .3 ampere, and a 150-watt lamp a little over 1 ampere. An electric flatiron draws about 4 amperes. It seems to me that a sixth-grade child may be expected to have an approximate idea of voltage and current consumption of these devices, just

as he might be expected to have an approximate idea of weight and dimensions of common objects. Would a sixth-grade child feel something wrong if he should hear of a man 12 feet high, or an automobile weighing 25 pounds? He should feel something wrong in the same way if something is said which implies operating a 110-volt device from a dry cell, or a current of 100 amperes in a house lighting circuit.

These circuits, and the ideas developed through studying them, may be used in many ways, and in turn may lead to other units of study. In our training school recently, a student teacher in training who had had some experience with circuits as described above in my science class was working with a sixth-grade class on the topic of the telephone. The problem of how the telephone works was broken down, after discussion, into three sets of problems dealing with (1) the action of the carbon button, (2) the action of the magnet in the receiver, and (3) the part played by sound waves in this process. A set of experiments was devised under each of these three subproblems, and then the class went back to the telephone as a whole. The teacher used the simple circuit with variable resistance to help make clear how the carbon button varied resistance in a telephone circuit. She also used it to show how varying the resistance in a circuit in which there was an electromagnet instead of a light varied the strength of the magnet. Considerable time was spent in helping the children understand the effect of varying resistance on strength of current. Then, when these children went back to a discussion of the transmission of speech by the telephone, the function of the carbon button and its effect on the magnet in the receiver were much more meaningful. Another student, in developing the use of electricity in the home, led the class to classify all the devices they could name into two groups, one composed of those devices which operate by producing heat (and light), the other composed of those which operate by producing motion. Setting aside the latter for future study, which would involve the study of electromagnets, she worked for a time with those devices which produce heat. Using the simple circuit described in the first part of this article, she substituted different kinds and sizes of wire for the electric light. She was thus able to show how heat is produced by a current and what the conditions are under which the most heat is produced. This demonstration also led to a study of the function of a fuse and how it works.

The next step is to develop the idea of electric power. What is it that is paid for when you buy electricity? A consideration of the first set of activities described may lead a pupil to ask such a question as this: "If one cell with a 1.25-volt bulb will give as bright a light as two cells with a 2.3-volt bulb, why go to the expense of making flashlights with two cells?" Another question may be raised as to the effect of the size of the cell. There is a great variety, so far as size and shape are concerned, of flashlight cells on the market. The same sized cell may be purchased at several different prices. Is one worth more than another? If so, why? Perhaps someone may suggest that one cell would not last as long as two cells. In paying for electricity we pay for the use of power for a certain length of time. It is fairly obvious that in getting our work done by electricity the amount of push behind the electrons (voltage) and the rate of flow of electrons (current) must both be considered. The unit which takes these both into account is the watt, a unit of power or rate of doing work, which, in electrical units, is the product of the voltage and the amperage. We are now ready to consider the thing which first surprises some students, namely, that the current consumed by an ordinary light bulb and by a tiny flashlight bulb may be nearly the same. But suppose we multiply the current by the voltage in each case. The product of the current carried by the light bulb on the

house circuit by its voltage will be about 40 watts; whereas in the case of the flashlight bulb it will be less than one watt. We buy electricity by the kilowatt-hour, that is, a thousand watts for an hour. Assume that we pay ten cents per kilowatt-hour, which is rather high. Two five-cent flashlight cells would have to operate for over a thousand hours if it supplied current at the same price rate. As flashlights are usually used only a few seconds at a time, it is obvious that flashlight cells have no such length of life. One of my students is at present building an apparatus to compare the length of life of different makes of flashlight cells. A motor-driven shaft is arranged to make contact with three circuits simultaneously, causing a bulb in each circuit to flash on and off. Each circuit is to be operated by a different make of dry cell. Each bulb will flash a given number of times per minute, and the length of time each cell continues to operate under these conditions may be determined.

Many other simple problems may now be worked out concerning the cost of operation of household appliances. If the wattage is known, and this is usually given on the device, by assuming 120 volts, or by finding out from the power company at what voltage current is delivered, the current consumption in amperes may be obtained. Then the resistance of the device can be calculated. By adding the current consumption of various devices on a single circuit, and comparing it with the fuse rating in a house circuit, one may tell how near such loading will come to blowing the fuse. This has many ramifications leading to series and parallel circuits, and so on, which form suitable materials for study in the seventh, eighth, and ninth grades. The latter part of this development as outlined above is probably too difficult even for sixth-grade pupils if they are starting from scratch with no science background. However, if this material is distributed throughout the six grades, it is not beyond the accomplishment of grade children.

This work may easily lead to other related areas which, in their turn, may be taken apart into a series of activities and understandings and arranged in an order which will provide material from the first grade up. The production of electricity by chemical action may be developed in this way, and at the same time the reverse of the process, the use of electricity in electroplating and other electrochemical industries. The use of electricity in devices which produce motion involves a study of electromagnets, and this in turn a study of magnetic fields. If the grade teacher in a primary grade is conscious of the possibilities of such materials through grades one to nine, she will be more likely to make a study of magnets in the second or third grade more meaningful and more effective than if she sees it merely as a group of activities, unrelated to anything else. The generation of electricity by the motion of a wire in a magnetic field, the principle underlying the production of electric power, lends itself to such a progressive development. The tremendously significant experiments of Oersted, Faraday, Henry, and others are simple enough to be done with simple, homemade equipment. There is a wealth of biographical material about such men that could be used. The relation of their discoveries to our present economic and social difficulties may appeal to the teacher who is interested in the social studies. Our children hear much of Edison, Marconi, Morse, and Watt. They hear little of Professor Henry, to whom Morse had to go to obtain the technical information about electromagnets he needed in order to construct a telegraph that would work. They hear little of Professor Black, the expert on the behavior of steam to whom Watt went for help. They hear little of Professor Hertz, who discovered the idea which Marconi used in his wireless, or of Professor Faraday, whose discovery was the foundation on which Edison constructed his generator. Perhaps we should hear more of the college professors,

research workers in the universities, whose theoretical work has nearly always been the basis on which the inventor has built. The struggles involved in such research do not easily lend themselves to popularization as do the struggles of the inventor to finance his idea. There is just as much drama to the scientist when some crucial experiment, planned in his laboratory, really works, and thus establishes a new fundamental relationship, but the drama is not so easily conveyed to others as is the first successful trip of a *Fulton's Folly,* or the first word sent over a telegraph wire.

TECHNIQUES FOR DEVELOPING PROBLEM SOLVING ABILITIES THROUGH SCIENCE TEACHING *

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Pupils come to us in the ninth year or are advanced from the ninth to the tenth year possessed of certain abilities and attitudes. Norms of such abilities and attitudes can be established. In an earlier article I suggested how these norms might be determined.

I am convinced that an advance or development of certain skills, abilities and attitudes is also possible of attainment. Unfortunately, we so far have evolved no definite and satisfactory scheme for measuring such developments. Honesty, initiative, dependability, cooperation, delayed judgment, openmindedness, reflective thinking—to name a few of the desirable abilities and outcomes—are all capable of improvement provided that we fully recognize the fact that the germs of all are inextricably woven into the very mental constitution of the child of high-school age.

To develop certain mental abilities is one of the prime reasons for including science in the secondary school curriculum. We have, however, long thought that the development of mental ability was an end in itself. That accomplished and all else would inevitably follow.

Our emphasis has fortunately changed, however, during the past few years. We have seen too many persons, supposedly mentally well equipped and balanced, turn out to be knaves, agitators or leading politicians. Mental ability is not an end in itself, but rather a means to an end and that end is character. Now character is the sum total of the outcomes mentioned above. It is a bundle of habits. We are now coming more and more to believe that character as a desirable outcome is the only one that will spell real success and avoid ruin for the individual and for our present disjointed civilization.[1] Reflective thinking controlled and guided to worthy ends is the solution of the problem of character building.

I believe that reflective thinking parallels the use of the scientific method of the solution of problems. That method involves naturally the five or six orderly steps which the scientist uses in investigation in experimental work. With this thought in mind it is becoming more and more apparent to me that we are largely overlooking three very important factors in the mental make-up of the ninth and tenth year high-school pupils. And if these factors are as important as I think they are, it seems to show that we are building our scientific

* Contribution to panel discussion at the meeting of N.A.R.S.T., Atlantic City, February, 1938.

[1] Wood, George C. "A Study in the Establishment of a Norm in Scientific Attitudes and Abilities Among Ninth-Year Pupils." *Science Education* 21: 140–146; October, 1937.

superstructure on a very weak and insecure foundation.

Now the factors which make up this unstable mental foundation are: (1) elementary school pupils think almost entirely deductively; (2) they are taught deductively either because that is the line of least resistance for the teachers to follow or because educators believe that is nature's way and, therefore, is the best way; and (3) at best but about three out of every ten pupils of high school age can read the printed page intelligently; that is, sense and appreciate what they read or get the meaning and connotation of a paragraph, no matter how simple the language or the ideas involved.

To put the case bluntly, the average high-school pupil today has little power to sense or grasp the meaning of anything he reads. He has little power to analyze a sentence into its component parts and then put them together again and make sense of the procedure. I say this for I have tried it in remedial reading in science classes many times during the past year.

It is perhaps not too much to say—and it may be high time—that our entire program of science teaching, even involving our new hopes for the development of outcomes and abilities, should be scrapped and set aside, and that we should begin all over again to do what the elementary school should have for its chief task, namely, the teaching of boys and girls to read intelligently. Without this ability there can be no real progress or advance in the building of character through reflective thinking because this kind of thinking presupposes something to think about. And nothing to think about is the curse of a vast number of people in the present day.

Continued patching is not a remedy. However, we see new structures being put up today on sites before the old ones are entirely pulled down. So, situated as we are with the problem facing us now, with no immediate prospect of an entire revolution in our ways of starting people to think along the right lines at the proper age, we are forced to do what remedial work we can with the hope that some good will come of it. It is this particular phase of this work that I plan to discuss.

A child instinctively enjoys pulling things to pieces to see what is inside them or what makes them click. With no sense of relative values he will pound to pieces a gold watch as readily as a tin one.

Again, the average child has very little constructive ability. His imagination pictures with difficulty a complete and finished product. He is, moreover, quite unable to take apart a defective unit and supply the missing parts necessary to complete the unit. This was well illustrated recently by three boys who set out to build a hut in an open piece of woods in my neighborhood. The ill-assorted lumber they had was not adapted to the ends sought; the incomplete product was highly unsatisfactory and in disgust these boys tore down the hut and scattered it to the four winds littering up a neighborhood landscape.

Now this inability of the pupil to construct is a natural one, to be sure, but unfortunately it has a negative carry-over value when it comes to constructing mental images as he reads the printed page. He founders about, getting no clear conception of the relation of parts of what he is reading and is utterly unable to integrate his hazy concepts into generalizations or composite impressions.

What to do? Fortunately the science teacher can fall back upon the child's propensity to take things to pieces. Equipped with some measure of ability in deductive reasoning in his elementary school training, why not use it for all it is worth while we are adjusting the pupil's mental apparatus to the inductive and inductive-deductive methods of thinking. By using the child's natural mental equipment, negative though it be in its relation to science teaching, we are taking advantage of a situation which really favors us.

I am suggesting here just five very

simple techniques which have been tried and found to be worth continuing as a permanent policy in a biology department.

1. Science is now generally taught in units which are in turn divided into general problems. Biology is well taught in this manner. For example, the first general problem to be taken up, developed and discussed may well be: What will some careful observations show us about some common living things in our environment? The procedure is as follows: (a) What are the most important words in this statement or question? In accordance with the pupil's natural instincts to pick things to pieces the discussion will settle upon the words: observations, things and environment. (b) What does observation mean? Answer: looking at something. A book is held up for all to look at. Volunteers are asked to describe what they see. A dozen answer, but no two answers are exactly alike, yet all may be true. A little more "looking" will settle upon come common features which all actually see. What again is observation? A careful study of and report upon some object. (c) Why use the word careful? Because errors may creep in. A physician observes or diagnoses a disease. The good observer dedevelops a great medical practice; the poor diagnostician covers up his mistakes with earth. (d) Why *some* observations? Because obviously the class cannot make all possible observations of all animals under study. (e) What are things? Objects that occupy space and have weight. (f) Are all things alike? They differ. Some are alive, some are non-living. (g) Why study living things? Because that is the content and scope of biology. (h) Why some living things? Because we cannot study all. (i) Why common? Because we cannot hope to study the rare ones directly. (j) Where are all the living things we are to observe? In an environment.

What is the result of this analysis of the problem? It is a clear-cut concept of just what the problem really is; what its parts are, their connotation and relationship to each other, their inclusive and exclusive limits. The problem as a whole and in its parts is always at instant recall as it is being solved and every form studied takes its proper place in the picture. A constant mental return to the parts of the problem accompanies the solution of the problem. These parts act as integrating units which constantly orientate the mind of the pupil as he proceeds. The problem is now read understandingly due to the reciprocating relations between it and the factors used to solve it. The pupil learns in time to read every problem more understandingly. The carry-over value in its bearing upon other succeeding problems in biology is obvious.

Of course, this procedure takes time. But why not take time? Which is more important, quantity or quality? Moreover, this type of work soon involves some of the very things we have been stressing in our recent science teaching, *i.e.,* delayed judgment, comparison, elimination, reflective thinking, openmindedness, *et cetera*. Does any one believe that such treatment of problems will not go a long way towards developing a technique which the pupil himself can use in solving problems? At every step the pupil knows what the problem calls for, the steps necessary to be taken to solve it, and the goal to be reached.

2. Another deductive-inductive procedure which I have reason to believe is full of promise is to assign the class a simple problem such as to bake a cake (for the girls) or build a kite or bird house (for the boys). Every pupil is asked to rehearse mentally the steps he or she would take in solving this constructive problem. Each pupil is then asked to write what he or she would do, or did, in the form of a story. This is constructive work which will be done in full accordance with the natural weaknesses of the pupil along this line. Gross errors will soon appear.

Several of these stories are read aloud in the class and after full discussion each step in the experimental method is identi-

fied. Further discussion will bring out the omissions in the stories read aloud and the fact that the order of the experimental steps is in many cases wrong. Still further discussion will bring agreement upon certain steps in the baking of bread or making a kite—a method and materials or materials and a method (these seem to be alternate in order), observations, conclusion and a practical application.

All members of the class are then asked (1) to identify these steps in their stories and (2) to note the order in which they appear. Some steps will have been omitted entirely. This is a common error and a common cause of discouragement and failure in the solution of many of life's problems.

Others find that the two steps most commonly omitted are the conclusion and the practical application. That is true to life. Too many people do not recognize a conclusion when it hits them in the face. Unable to recognize a conclusion, no practical application is, of course, possible.

Many will find their steps sadly out of order. The whole process here is one of analysis and deduction. The next step is one of induction. It is also one of construction and integration, done in the light of recent errors and now in the belief that better things are possible.

So the desired goal is now to get the pupils to become so familiar with the logical steps to be taken in problem solving that (1) they can instantly recognize these steps in any problem, (2) they can construct a bit of apparatus, work out a problem, or do a project in accordance with these steps and, best of all, (3) they may become so familiar with this correct procedure that they will carry *unconsciously* through any problem following the proper steps in their right order to a definite and satisfactory end. By this method failures must be less and less, and accomplishments more and more numerous. Accomplishment breeds confidence and, in the final analysis, spells success.

3. Another method is the selection of the most important terms in any one problem, topic or unit. These terms are listed in the note books as the work proceeds. At the close of the topic, for example, these words are placed in columnar form and after each are added enough other words to form a complete sentence in which the meaning of the Key Word is made plain. The connotation of each term must be known if the sentence states a fact or it is a true statement. Finally, a given number of both remotely and closely related terms are given to the class at one time. Its task is now to write a short story in which every one of the listed terms is used in its proper meaning and in its proper relation to every other term. Here is analysis, construction, connotation and integration together. I know of no better method by which powers of expression and the proper use of terms, and an increased vocabulary, are so furthered. All this helps tremendously in the ability to read intelligently.

4. Still another valuable method of developing a full understanding of relationships between terms and a full sense of their connotations is through the use of simple flow charts such as might be developed in connection with the relation of food chains, tracing energy transformations back to the sun or the energy of the sun to the driving of a nail. For example, a fundamental need of all life forms is food. In a study of bacteria this is fundamental and interest is centered in the dangers of bacteria due directly to satisfying this need. The need suggests the nature of the foods used by bacteria. Since some foods are solid they must be treated by bacteria to be absorbed. But some of the foods are living lung tissue and some are non-living (carrion, milk, *et cetera*). Thus some bacteria become saprophytes while other become parasites. The first group make foods unusable to us or disintegrate dead matter into its elements to be used again in the wheel of life. Thus there are useful and harmful bacterial parasites. The parasites

feed upon our body tissues causing diseases and are thus harmful parasites.

Now since the conditions for proper food absorption are heat and moisture, a soluble food and, in most cases, darkness, the growth of bacteria may be checked, controlled or destroyed by refrigeration, intense light, pasteurization, boiling, pickling, salting, canning, candying, antiseptics, *et cetera.* Again, so far as the human body is concerned, both natural and artificial lines of defense are set up as antibodies, antitoxins, agglutinins, *et cetera,* in the blood and vaccination, antitoxins, serums, placed in the body.

All of the above may be worked out in diagrammatic form as a real flow chart of ideas so that the pupil may read it in either direction, inductively or deductively with emphasis upon relationships and the telescoping of smaller units and ideas into larger ones or the recognition of the component parts of any one step in the chart. Again, these concepts must in my opinion have their bearing upon intelligent reading of any biology content.

5. Finally, I believe that improvement in laboratory work is possible because of greater integration and better analysis of definitely stated problems. It has been my experience that too much laboratory work may become busy work strung out in what I call a linear progression without much breadth and little depth. It is often very thin in spots because it involves no integrating principle strong enough to weave the whole exercise into a workable unit. The result is that too few valid conclusions are drawn and lasting impressions made.

The old laboratory method with some newer aspects added presented itself to me. A problem is set before the class when insects, for example, are taken up as a study. The usual way is to study the structure of the grasshopper as a type form. In the modified method the grasshopper is taken up as a real problem and this may be stated as follows: Why are grasshoppers a menace to agriculture or to the farmer? Here is something to put one's teeth into. It is a problem of analyzing a statement as outlined in our first point and then integrating the parts in accordance with the experimental method.

With the problem stated, the insect is placed before the pupils for inspection and observation. Things begin to dawn upon their minds at once. The apparatus needed to work out the problem is listed: pencils, paper, hand lenses, specimen. The method is discussed. This involves the observation of all parts, determining their functions, and seeing the relationships between them. Then a sketch is made to drive home the observations. All important parts are labeled.

The conclusion now looms up. Looking again at the problem as stated, the conclusion may be readily drawn that the grasshopper is a highly specialized animal, having extremely good adaptations for locomotion by means of two pairs of wings and three pairs of legs, the hind pair of legs being very muscular. It has keen sense organs (ocelli, compound eyes, ears and antennae). It is well protected against mechanical injury by its tough chitinous exoskeleton and it is fitted with strong jaws for voracious eating. Because of this excellent equipment it (1) is most destructive to crops, (2) readily escapes its enemies, and (3) is difficult to catch and control.

The practical application would be: the development of means of control. Poisons at once suggest themselves. Also the objections to them appear. Next ditching and barriers to flight, which are low because of the weight of the insect, are suggested. These are actually used by farmers.

The result must be a clear cut sense of the relations between structure, function and economic importance. Furthermore, a logical presentation is made throughout which develops logical recall in the minds of the pupils which in turn makes for better expression in thought wholes.

To sum up: Our technique in developing the problem-solving ability of pupils is essentially the development of a proper reading ability and logical thought analysis and integrating ability. All involve deductive and inductive thinking. If we can get these things "across" we may then begin to think with confidence about outcomes, now so commonly mentioned, such as intellectual honesty, recognition of cause and effect relations, openmindedness, delayed judgment. All of these are attainable provided the pupil is furnished the proper tools with which to achieve them and that is principally the ability to read and to analyze a problem intelligently.

I am fully confident of one thing. These methods I have outlined when tried on a common run-of-the-mill class resulted in unmistakable signs of an increased ability to think straight. While this class did not for obvious reasons have at its tongue's end a large array of facts, its members were, nevertheless, better able to use what facts they did possess in arriving at correct generalizations.

In conclusion, I should like to say that I am now convinced it is going to be a long time before we shall be able to evaluate the outcomes of science teaching in terms of percentages. However, I am not at all worried about that. To my way of thinking, it will be fully sufficient if we can actually recognize the presence of these behavior outcomes in any individual and can also see signs of their growth and expansion. If this be possible we may call our work successful. For this recognition is no more and no less than the best business executives and captains of industry hope to achieve in selecting men for responsible executive positions and in looking for qualities that mean promotion and continued success.

THE RELATIVE VALUE OF SOUND MOTION PICTURES AND STUDY SHEETS IN SCIENCE TEACHING *

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Within the last few years there has arisen the problem of the use and value of educational sound motion pictures in classroom teaching. Educators are not unmindful of their importance, but they are continually asking themselves such questions as these: What are the possibilities of educational sound motion pictures? Do salesmen overemphasize their value as teaching aids? To what extent can they profitably be used for direct teaching?

At least six investigations have been made to determine the value of educational sound films when used in various ways. Arnspiger's [1] study indicated that the learning of groups taught by sound films was superior to that of groups taught without sound films to a statistically significant degree. The percentage of superiority ranged from eighteen to thirty-four. Rulon [2] found that groups studying with the aid of sound films showed a superiority of 20.5 per cent over the groups studying without such aid. On a test given several months later, the sound film groups showed a superiority of 38.5 per cent over the non-

* A field study which was submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Colorado State College of Education, Greeley, Colorado, 1938.

[1] Arnspiger, V. C. *Measuring the Effectiveness of Sound Pictures as Teaching Aids.* Contributions to Education, No. 565. Teachers College, Columbia University, New York, 1933.

[2] Rulon, P. J. *The Sound Motion Picture in Science Teaching.* Cambridge: Harvard University Press, 1933.

film group. Clark[3] made a study in which he found that sound films were superior to silent films and lectures in stimulating interest. In maintaining interest already possessed by students, sound films and silent films proved to be about equally effective and to have a slight advantage over lecture demonstrations. The experiment conducted by Einbecker[4] showed that verbal accompaniments increase the comprehension over that secured from films without caption or comment. The findings of Westfall's[5] investigation showed that explanations prepared by the teacher from material furnished with the film, a lecture furnished with the film and read by the teacher, and the usual captions were about equal as aids to understanding the contents of the film; these three forms of verbal accompaniment were superior to long captions. Hansen[6] found that verbal explanation accompanying an educational talking picture can be presented as effectively by the classroom teacher as by the medium of the recorded voice from the sound motion picture projector.

This study was made to determine the relative value of two methods of direct instruction: (1) By the use of educational sound motion pictures; and (2) by the use of printed study sheets, made to resemble parts of science texts and workbooks as nearly as was practical.

PREPARATION FOR TEACHER

This investigation was carried on during the school year of 1937–1938 in the Horace Mann Junior High School of Tulsa, Oklahoma. Eighth grade science pupils were paired, using as bases mental age, science reading ability, and sex. The mental age of each pupil was determined by the Henmon-Nelson Test of Mental Ability. To determine science reading ability a form of the Van Wagenen Reading Scales in General Science were administered to the pupils. A composite score was determined for each pupil, by using a factor which was obtained from the quartile deviations of the mental ages in months and the raw scores on the Van Wagenen Tests. At the beginning of the experiment there were 320 pupils, but because of illness, change of residence, or other reasons for absence, this number had been reduced to 280 pupils, or 140 pairs, at the end of the experiment. For convenience the two groups were called the X-group and the Y-group.

Four films by Erpi Classroom Films, Inc., were used in this study: The House Fly, The Work of Rivers, Ground Water, and The Work of the Atmosphere. The study sheets consisted of two parts. The first part was made to resemble a part of a science textbook, and the second part was constructed to resemble a part of a science workbook. In preparing the study sheets, the lecture in the manual accompanying each Erpi film was used. Each lecture was well organized and almost complete in itself. This lecture was changed only in a few minor ways, so that it would be understandable without the accompanying motion picture. The workbooks used to supplement the texts were carefully constructed, using the content of the texts as bases. Three science instructors aided in the making of each workbook section, by selecting from the text sections the items which they thought should be stressed in the workbooks. The phraseology of the text was maintained. The number of factual items in the four workbook sections varied from twenty-one to twenty-six.

[3] Clark, C. C. "The Talking Movie and Students' Interests." *Science Education* 17: 312–320; December, 1933.

[4] Einbecker, W. F. "Comparison of Verbal Accompaniments to Films." *Education* 53: 343–347; February, 1933.

[5] Westfall, L. H. *A Study of Verbal Accompaniments to Educational Motion Pictures.* Contributions to Education, No. 617. New York: Teachers College, Columbia University, 1934.

[6] Hansen, J. E. "Verbal Accompaniment of the Educational Film—The Recorded Voice vs. The Voice of the Classroom Teacher." *Journal of Experimental Education* 5: 1–6; September, 1936.

A multiple-choice test covering factual material was constructed for each of the four subjects used in this investigation. Each test consisted of twenty-eight items, with four numbered responses for each item. The reliability of each test was determined when it was used for immediate recall. When the reliabilities were calculated by use of the chance halves method and the Spearman-Brown formula, they ranged from .745 to .810.

PROCEDURE

For teaching the first subject, the House Fly, the X-group was taught by the use of the sound film and the Y-group was taught by the use of the study sheets. The film was run twice, without comment from the teacher. The Y-group was taught with the corresponding study sheets, using exactly the same length of teaching time as was used for the X-group—the length of time needed for two showings of the film. At the end of the teaching period, all pupils were tested for immediate recall. After thirty days they were tested for delayed recall. The groups were then rotated, and taught and tested for the next subject. Thus each pupil was taught twice with films and twice with study sheets.

As a supplementary study to the main experiment, a questionnaire was given to gather the pupils' judgment of the two methods of teaching. Of the 300 pupils replying, 70.3 per cent preferred the sound film to the study sheet method of teaching; 62.6 per cent thought they learned more by the sound film than they did by the use of the study sheets.

STATISTICAL TREATMENT OF DATA

The means for the scores on each test were computed, when the tests were given for immediate recall and also when they were given for delayed recall. This was done separately for each subject and for each of the two methods of teaching. From the table it should be noted that for each subject the difference between the immediate recall means and the delayed recall means is less for the sound film method than for the study sheet method.

In computing the S.E. of the differences between means, the formula given by Peters and VanVoorhis [7] was used:

$$\sigma m_x - m_y = \frac{\sigma d}{\sqrt{N}} \sqrt[4]{1-r_{xc}^2}\ \sqrt[4]{1-r_{yc}^2}$$

The d refers to the standard deviation of the differences between test scores of each pair. The r_{xc} refers to the correlation between test scores by one method and composite scores, or the scores used for the purpose of matching; and r_{yc} refers to the correlation between test scores of the second method and the composite scores.

Odell [8] outlines the procedure for determining the experimental coefficient. It is found by dividing the difference of the means by 2.78 times the S.E. of the difference. He says, "The multiplier in the denominator, 2.78, was chosen so that when the value of the fraction equals one the chances of a difference being significant are great enough that they can be considered practical certainty."

The data collected in this experiment indicate that when testing for immediate recall, study sheets are superior to sound films to a statistically significant degree. The means and the differences of the means for the two methods of teaching are shown in the table. The experimental coefficients, as shown in the table, range from 1.10 in the case of the subject Ground Water to 1.87 in the case of the subject The House Fly.

The results of the tests for delayed recall show that in only one subject, The House Fly, was the study sheet method

[7] Peters, C. C., and VanVoorhis, W. R. *Statistical Procedures and Their Mathematical Bases*, p. 144. State College, Pennsylvania: The Pennsylvania State College, 1935.

[8] Odell, C. W. *Statistical Method in Education*, pp. 355–360. New York: D. Appleton-Century Company, 1935.

superior to the sound film method to a statistically significant degree. In this subject, the experimental coefficient was 1.13. In the other three subjects the study sheet method was not superior to the sound film method from a statistical standpoint, as the ratios were not significant, being .56 for The Work of Rivers, .41 for The Work of the Atmosphere, and —.29 for Ground Water.

TABLE I

THE MEANS, THE DIFFERENCES OF THE MEANS, THE STANDARD ERRORS OF THE DIFFERENCES OF THE MEANS AND THE EXPERIMENTAL COEFFICIENTS, WHEN THE TESTS WERE USED FOR IMMEDIATE AND DELAYED RECALL

Subject	Means		Difference of means	S. E.	Experimental coefficients
	Study Sheet	Film			
Immediate Recall:					
1. The House Fly	24.00	22.76	1.24	.238	1.87
2. The Work of Rivers	21.24	19.74	1.50	.302	1.79
3. Ground Water	21.30	20.39	.91	.297	1.10
4. The Work of the Atmosphere	18.93	17.68	1.25	.279	1.61
Delayed Recall:					
1. The House Fly	21.26	20.34	.92	.293	1.13
2. The Work of Rivers	18.81	18.25	.56	.359	.56
3. Ground Water	18.08	18.29	—.21	.265	—.29
4. The Work of the Atmosphere	15.15	14.85	.30	.261	.41

CONCLUSIONS

In this investigation, study sheets and educational sound motion pictures were used only as direct teaching devices. The data indicate a statistically significant difference in favor of study sheets over sound films, when testing for immediate recall. When testing for delayed recall, the differences of learning by the two methods were not significantly in favor of either method from a statistical standpoint.

Insofar as the results of this study are indicative, it can be inferred that pupils taught with sound films retain factual material better than pupils taught with study sheets. In other words, if two pupils receive the same score on a test for immediate recall, the probability is that the pupil taught by sound film will score higher on the delayed recall test than the pupil taught by study sheets.

If pupil interests are to be considered in teaching, and if the equipment is available, more general use might be made of sound films, since 70.3 per cent of the pupils in this experiment expressed a preference for the use of sound films over study sheets.

SCIENCE READING MATERIALS FOR PUPILS AND TEACHERS—III

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The invention of printing did more to advance civilization than any other single factor. Without this invention, education and the resulting diffusion of knowledge would have been significantly meager if measured according to our present standards. Education would have been limited to a relatively few and made available only to these at a comparatively high cost. Truly it may be said that our civilization rests upon books, magazines and newspapers. In the first mentioned, the cultural heritage and the enriching accumulation of experiences of the past, together with the challenging thoughts of tomorrow, become the prized possessions of today, available alike to any who read and learn. Books, today, constitute the most active, forwarding force in our civilization. They are not only sources of information and facts, but also stimulators of activity—they arouse us from our complacency. And since education does not end with formal classroom work, books offer the best medium for the continuing process of education. As a whole books are more adequate and reliable as sources of information and facts than are magazines, newspapers and the radio. In this latter fact, science books can probably be accorded the high distinction of being the most reliable, accurate, unbiased, unprejudiced source of information we have.

A wider use of books is the one best assurance of advancing the social order, keeping us free from "isms,"[1] and for the making of a free democracy. In order to promote a wider use of books, the postage on books has been reduced to a cent and a half a pound, irrespective of destination, by an executive decree of President Roosevelt. While the decree is effective only until June 30, 1939, the writer believes the new rate will prove to be one extension of federal aid in education which all citizens will welcome.

The present bibliography includes books published during the period 1936–1938. One of the pleasing trends in science books published during this period is the increased use of good pictures, often in monochrome. The quality of the pictures has been greatly improved. A second noticeable trend has been the greatly decreased number of books popularizing chemistry. This probably does not indicate a lessened interest in chemistry, but that the materials in this field were to a great extent exhausted during the period preceding 1935.

The most significant development of the last three years has been the increased number of books on photography. This confirms other evidences of a great popular interest in this field. Probably photography (at least extending as far as the taking of pictures) has been the most rapidly developing hobby since radio. There are a score or more magazines now devoted to photography. The interest in pictures is also manifested by the record-breaking sales of picture magazines. Special excursion trains for photography fans are being run from some cities. Significantly, this somewhat sudden interest in photography by amateurs is coincident with the first practical development of photography in 1838. Is this interest a passing fancy or will it likely be quite permanent? Evidence would indicate the latter. What are science teachers doing about this new activity? If they are not actively aware of it, they may be said to be just that much out of touch with the leisure time activities of a great many of our citizens.

Some books are to be tasted, others to be swallowed, and some few to be chewed and digested.—Francis Bacon.

For books are more than books, they are the life, the very heart and core of ages past, the reason why men lived and worked and died, the essence and quintessence of their lives.—Amy Lowell.

PART I

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J. PHOTOGRAPHY

Anonymous. How to Enlarge; Vivid Portraits; Secret of Exposure; Practical Retouching; Choosing a Lens; Light Filters; Action Snapshots. Photographic. $0.50 each.

Barleben, Karl. Travel Photography. Fomo, 1936. 64 p. $0.50.

Blair, Julian M. Practical and Theoretical Photography. Pitman, 1938. 237 p. $2.00.

Campbell, Heyworth. Camera Round the World. McBride. 128 p. $3.00.

Collins, A. Frederick. Photography for Fun. Appleton, 1939. 391 p. $3.00.

Croy, Otto R. Secrets of Trick Photography. Photographic, 1937. 173 p. $2.50.

Davis, William S. Practical Amateur Photography. Brown, 1938. 264 p. $2.25.

Deschin, Jacob. Making Pictures with the Miniature Camera. McGraw, 1937. 156 p. $3.00.

——— New Ways in Photography. Whittlesey, 1936. 307 p. $2.75.

Dmitri, Ivan. How To Use Your Candid Camera. Studio, 1936. 135 p. $3.50.

Doubleday, Russell. Photography is Fun. Doubleday, 1938. 95 p. $1.50.

Dutton, Laurence. Perfect Print Control. Galleon, 1937. 160 p. $2.50.

Frapie, Frank R. The American Annual of Photography. Photographic, 1936. 324 p. $1.50.

——— 1937. 332 p. $1.50.

——— 1939. 330 p. $1.50.

——— and O'Connor, F. C. Photographic Amusements. Photographic, 1937. 247 p. $3.50.

——— and Jordan, F. I. Photographic Hints and Gadgets. Photographic, 1937. 316 p. $3.50.
Gregory, Carl L. Motion Picture Photography. Falk, 1938. 435 p. $6.00.
Hamilton, Edwin T. Trick Photography. Dodd, 1938. 139 p. $2.50.
Henney, Keith. Color Photography for the Amateur. Whittlesey, 1938. 281 p. $3.50.
Herrschaft, William and Deschin, Jacob. Lighting Ideas in Photography. Whittlesey, 1938. $2.75.
Holme, C. G. Modern Photography 1937–38 Studio, 1937. $3.50.
——— Modern Photography 1938–39. Studio, 1938. $3.50.
Johnson, Robert. Art of Retouching Photographic Negatives. Photographic, 1936. 154 p. $2.50.
Jordan, Franklin I. Photographic Enlarging. Folmer, 1935. 224 p. $3.50.
Maloney, T. J. U. S. Camera 1936. Morrow, 1936. 238 p. $2.90.
——— U. S. Camera 1939. Morrow, 1939. $2.90.
Mees, C. E. Kenneth. Photography. Macmillan, 1937. 227 p. $3.00.
Morgan, Willard D. and Lester, Henry M. Miniature Camera Work. Morgan, 1938. 301 p. $4.00.
——— Leica Manual. Morgan, 1938. 586 p. $4.00.
Neblette, C. B., Brehm, Frederick, and Priest, Everett L. Elementary Photography. Macmillan, 1936. 253 p. $0.76.
Neblette, C. B. Photography: Principles and Practice. Van Nostrand, 1938. 590 p. $6.00.
Price, Jack. News Photography. Round Table 1937. 192 p. $3.50.
Ross, Kip. Night Photography with Miniature Camera. Fomo, 1937. 68 p. $0.75.
Saccheri, Mario, and Saccheri, Mabel. The Fun of Photography. Harcourt, 1938. 374 p. $3.50.
Simon, Richard. Miniature Photography. Simon, 1937. 168 p. $1.75.
Simpson, Charles. Composition for Photography. Photographic. 191 p. $4.00.
Spencer, Douglas A. Color Photography in Practice. Pitman, 1938. 275 p. $6.00.
——— Photography Today. Oxford, 1936. 160 p. $1.50.
Symposium. Photo Almanac and Market Guide. Falk, 1937. 215 p. $1.00.
——— Falk, 1938. $1.00.
Taft, Robert. Photography of the American Scene. Macmillan, 1938. 546 p. $10.00.
Taylor, G. H. (Editor). My Best Photograph and Why. Dodge, 1937. 90 p. $3.00.
Thorek, Max. Creative Camera Art. Fomo, 1937. 156 p. $3.75.
Van Gelder, Robert. Smash Picture. Dodd, $2.00.
Williams, Herbert. Portrait Photography. Chemical, 1937. 68 p. $4.00.

PART II

COLLEGE TEXTBOOKS

A. BIOLOGY

Barrows, Henry R. Elements of General Biology. Farrar, 1936. 435 p. $2.60.
Buchanan, Estelle and Buchanan, Robert Earle. Bacteriology. Saunders, 1938. 546 p. $3.50.
Hegner, Robert W. College Zoölogy. Macmillan, 1936. 702 p. $3.50.
Heilbrunn, H. L. An Outline of General Physiology. Saunders, 1937. 603 p. $5.00.
Holman, Richard M. and Robbin, Wilfred W. A Textbook of General Botany. Wiley, 1938. 664 p. $4.00.
Newman, Horatio H. Outlines of General Zoölogy. Macmillan, 1936. 661 p. $3.50.
Rice, Thurman B. A Textbook of Bacteriology. Saunders, 1938. 563 p. $5.00.
Walter, Herbert Eugene. Genetics. Macmillan, 1938. 535 p. $3.75.
Woodruff, Lorande Loss. Foundations of Biology. Macmillan, 1936. 583 p. $3.50.
——— Animal Biology. Macmillan, 1938. 535 p. $3.75.

B. CHEMISTRY

Brinkley, Stuart R. Introduction to General Chemistry. Macmillan, 1938. 731 p. $3.00.
Holmes, Harry N. General Chemistry. Macmillan, 1936. 700 p. $3.50.
Mathews, Albert P. Principles of Biochemistry. Wilkins, 1936. 512 p. $4.50.
MacLeod, Annie Louise and Nason, Edith H. Chemistry and Cookery. McGraw, 1937. 568 p. $3.50.
Partington, J. R. Textbook of Inorganic Chemistry. Macmillan, 1937. 1062 p. $4.60.
Rose, Mary Swartz. The Foundations of Nutrition. Macmillan, 1938. 163 p. $1.75.

C. PHYSICS

Avery, Madalyn. Household Physics. Macmillan, 1938. 439 p. $3.50.
Caswell, Albert E. An Outline of Physics. Macmillan, 1938. 590 p. $3.75.
Millikan, Robert Andrews, Roller, Duane, and Watson, Ernest C. Mechanics, Molecular Physics, Heat and Sound. Ginn, 1937. 498 p. $4.00.
Millikan, Robert A., Gale, Henry G., and Edwards, Charles. A First Course in Physics for Colleges. Ginn, 1938. 712 p. $4.00.
Spinney, Louis B. A Textbook of Physics. Macmillan, 1937. 721 p. $3.75.
Williams, Samuel R. Foundations of Physics. Ginn, 1937. 630 p. $4.00.

D. GEOLOGY

Blair, Thomas A. Weather Elements. Prentice, 1937. 401 p. $5.00.
Emmons, William H., et al. Geology: Principles and Practices. McGraw, 1938. 447 p. $3.75.

Schuchert, Charles and Dunbar, C. O. Outlines of Historical Geology. Wiley, 1937. 241 p. $2.50.

Trewatha, Glenn T. An Introduction to Weather and Climate. McGraw, 1937. 373 p. $3.00.

E. GEOGRAPHY

Carlson, Fred A. Geography of Latin America. Prentice, 1937. 642 p. $4.00.

Dodge, Richard E. and Dodge, Stanley D. Foundations of Geography. Doubleday, 1937. 490 p. $3.75.

Finch, Vernon C. and Trewatha, Glenn. Elements of Geography. McGraw, 1936. 782 p. $4.00.

Parkins, A. E. The South and Its Economic-Geographic Development. Wiley, 1938. 528 p. $4.00.

Ridgley, Douglas C. and Ekblaw, Sydney E. Influence of Geography in Our Economic Life. Gregg, 1938. 658 p. $1.84.

White, C. Langdon and Renner, George T. Geography. Appleton, 1936. 790 p. $4.00.

PART III

PUPIL REFERENCES (HIGH SCHOOL)

A. PHYSICS

Collins, A. Frederick. Fun With Electricity. Appleton, 1936. 238 p. $2.00.

Morgan, Alfred. Things a Boy Can Do with Electricity. Scribners, 1938. 243 p. $2.00.

Nicolay, Helen. Wizards of the Wires. Appleton, 1938. 326 p. $2.50.

B. CHEMISTRY

Bunzell, Herbert H. Everyday With Chemistry. Grossett, 1937. 128 p. $1.25.

Collins, A. Frederick. The March of Chemistry. Lippincott. 275 p. $3.00.

Davis, Lavinia R. Adventures in Steel. Modern, 1938. 166 p. $0.75.

C. ASTRONOMY

Editorial Staff of Popular Science Monthly. Astronomy for Amateurs. Grosset, 1935. 192 p. $1.00.

Proctor, Mary. Our Stars Month by Month. Warne, 1937. 92 p. $1.00.

Swezly, Goodwin and Gable, J. H. Boys Book of Astronomy. 1936. 291 p. $2.00.

Wylie, Charles C. Our Starland. Lyons, 1938. 378 p. $0.88.

D. BIOLOGY

Boulenger, Edward G. World Natural History. Scribners, 1938. 268 p. $3.00.

Bronson, Wilfrid. The Wonder World of Ants. Harcourt, 1937. 87 p. $1.50.

Butler, Lorine L. Birds Round the Year. Appleton, 1937. 241 p. $2.00.

Butler, Mary C. Happy Nature Adventures. Dorrance, 1937. 113 p. $1.50.

Chapman, Wendell and Chapman, Lucie. Wilderness Wanderers. Scribners, 1937. 318 p. $3.75.

Curtis, Brian. The Life Story of the Fish. Appleton, 1938. 260 p. $3.00.

Ditmars, Raymond L. The Fight to Live. Stokes, 1938. 232 p. $2.50.

——— Making of a Scientist. Macmillan, 1937. 258 p. $2.75.

——— and Bridges, William. Wild Animal World. Appleton, 1937. 300 p. $3.00.

——— Book of Insect Oddities. Lippincott, 1938. 62 p. $2.00.

Dowd, Mary T. and Dent. Elements of Food and Nutrition. Wiley, 1937. 279 p. $1.75.

Fry, Walter and White, John R. Big Trees. Stanford, 1938. 126 p. $1.25.

Hawkes, Clarence. Notes of a Naturalist. Christopher, 1938. 127 p. $1.25.

Kenly, Julie Classon. Little Lives. Appleton, 1938. 271 p. $2.50.

Lippincott, Joseph W. Animal Neighbors of the Country Side. Lippincott, 1938. 272 p. $2.50.

McClintock, Theodore. The Underwater Zoo. Vanguard, 1938. 111 p. $1.75.

McFarland, J. Horace. Roses of the World in Color. Houghton, 1936. 296 p. $3.75.

Morgan, Alfred. An Aquarium Book for Boys and Girls. Scribners, 1936. 180 p. $2.00.

Patch, Edith M. and Fenton, C. L. Forest Neighbors. Macmillan, 1938. 198 p. $1.50.

Pillsbury, Arthur C. Picturing Miracles of Plant and Animal Life. Lippincott, 1937. 236 p. $3.00.

Pitt, Frances. Nature in the Wild. Scribners, 1936. 95 p. $2.00.

Quinn, Vernon. Leaves, Their Place in Life and Legends. Stokes, 1937. 211 p. $2.00.

Seton, Ernest T. Great Historic Animals. Scribners, 1937. 320 p. $2.50.

Schmid, Bastian. Interviewing Animals. Houghton, 1937. 223 p. $3.00.

Sheckell, Thomas O. Trees. Stokes, 1936. $4.00.

Shoosmith, F. H. Life in the Animal World. McBride, 1937. 278 p. $2.50.

Step, Edward. Marvels of Insect Life. McBride, 1938. 486 p. $3.75.

Stowell, Thora. Ways of Birds. Scribners, 1937. 174 p. $2.00.

Sutton, George M. Birds in the Wilderness. Macmillan, 1936. 200 p. $3.50.

United States Department of Agriculture. Famous Trees. Agriculture, 1938. 115 p. $0.15.

Verill, A. Hyatt. Stronge Reptiles and Their Stories. Page, 1937. 196 p. $2.50.

——— My Jungle Trails. Page, 1937. 329 p. $3.50.

——— Strange Birds and Their Stories. Page, 1938. 203 p. $2.50.

Watson, E. L. Grant. Mysteries of Natural History. Stokes, 1937. 244 p. $1.75.

E. GENERAL

Boff, Charles S. Boys Book of the Sea. Dutton, 1938. 225 p. $2.00.
Editorial Staff of Popular Science Monthly, A Book of Formulas, Recipes, Methods and Secret Processes. Grosset, 1936. 250 p. $1.00.
Fitzhugh, Jr., Ed. Treasures in the Earth. Caxton, 1936. 130 p. $2.00.
Fox, Lorene K. Antarctic Ice Breakers. Doubleday, 1937. 319 p. $2.50.
Glover, Katherine. America Begins Again. McGraw, 1939. 382 p. $1.76.
Huxley, Julian and Andrade, E. N. daC. More Simple Science. Harper, 1936. 350 p. $2.50.
Low, Archibald. Science for the Home. Nelson, 1938. 342 p. $1.50.
Mayer, Joseph. The Seven Seals of Science. Appleton, 1937. 430 p. $3.00.
Rosendahl, Charles E. What About Airships? Scribners, 1938. 437 p. $3.50.
Shand, Samuel. Earth Lore. Dutton, 1938. 144 p. $1.25.

PART IV

HIGH SCHOOL TEXTBOOKS

A. SENIOR HIGH SCHOOL PHYSICAL SCIENCE

Bush, George L., Ptacek, Theodore W., and Kovats, John. Senior Science. American, 1937. 835 p. $2.20.
Eckels, Charles F., Shaver, Chalmer B., and Howard, Bailey W. Our Physical World. Sanborn, 1938. 801 p. $2.20.

B. GENERAL SCIENCE

Beauchamp, Wilbur F., Mayfield, John C., and West, Joe Young. Science Problems. Book I. Scott, 1938. 432 p. $1.28. Book II. 1939. 548 p. $1.48.
Caldwell, Otis W. and Curtis, Francis D. Science for Today. Ginn, 1936. 755 p. $1.68.
Carpenter, Harry A. and Wood, George C. Modern Science Series. Allyn.
I. Our Environment: Its Relations to Us. 1937. 427 p.
II. Our Environment: How We Adapt Ourselves to It. 1937. 554 p.
III. Our Environment: How We Use and Control It. 1937. 846 p.
Davis, Ira C. and Sharp, Richard W. Science: A Story of Progress and Discovery. Holt, 1936. 491 p. $1.72.
Gruenberg, Benjamin and Unzicker, Samuel. Science in Our Lives. World, 1938. 764 p. $1.76.
Obourn, Ellsworth Scott, and Heiss, Elwood D. Modern Science Problems. Webster, 1936. 322 p. $1.44.
Pieper, Charles John and Beauchamp, Wilbur L. Everyday Problems in Science. Scott, 1936. 746 p. $1.60.
Platt, J. G. et al. General Science. Chemical, 1938. 167 p. $1.50.
Trafton, Gilbert H. and Smith, Victor C. Science in Daily Life. Lippincott, 1936. 689 p. $1.25.
Van Buskirk, Edgar F., Smith, E. L., and Nourse, E. L. Science in Everyday Life. Houghton, 1936. 634 p. $1.60.
Watkins, Ralph K. and Bedell, Ralph C. General Science for Today. Macmillan, 1936. 715 p. $1.72.

C. PHYSICS

Black, Newton Henry and Davis, Harvey N. Elementary Practical Physics. Macmillan, 1938. 690 p. $2.00.
Clark, John A., Gorton, Frederick R., and Sears, Francis W. Physics for Today. Houghton, 1938. 632 p. $1.80.
Fletcher, Gustav L., Mosbacher, Irving, and Lehman, Sidney. Unified Physics. McGraw, 1936. 662 p. $1.80.
Fuller, Robert W., Brownlee, Raymond B., and Baker, D. L. First Principles of Physics. Allyn, 1937. 805 p.
Idelson, Michael N. Mastery Units in Physics. Colonial, 1936. 250 p. $0.67.
Masson, Louis T. Physics Made Easy. Smith, 1938. 384 p. $1.00.
Millikan, Robert A., Gale, Henry G., and Coyle, James P. New Elementary Physics. Ginn, 1936. 637 p. $1.80.
Wilson, Sherman. Descriptive Physics. Holt, 1936. 231 p. $1.20.
Wright, Forrest B. Electricity in the Home and on the Farm. Wiley, 1935. 320 p. $2.50.

D. BIOLOGY

Benedict, Ralph C., Knox, Warren W., and Stone, George K. High School Biology. Macmillan, 1938. 728 p. $2.00.
Blount, Ralph A. The Science of Everyday Health. Allyn, 1936, 1937. 415 p. $1.20.
Heiss, Elwood D., Obourn, Ellsworth S., and Manzer, J. Gordon. Our World of Living Things. Webster, 1936. 343 p. $0.39.
Kinsey, Alfred Charles. New Introduction to Biology. Lippincott, 1938. 845 p. $1.76.
Kroeber, Elsbeth and Wolff, W. H. Adventures with Living Things. Heath, 1938. 798 p. $1.96.
Meier, W. H. D. and Shoemaker, Lois Meier. Essentials of Biology. Ginn, 1938. 700 p. $1.80.
Moon, Truman and Mann, Paul. Biology. Holt, 1938. 866 p. $2.60.
Smallwood, William M., Reveley, Ida L., and Bailey, Guy A. New Biology. Allyn, 1937. 644 p.
Wood, George C. and Carpenter, Harry A. Our Environment: The Living Things In It. Allyn, 1938. 1077 p.

E. CHEMISTRY

Baughman, Imo P. Elementary Chemistry with Practical Applications. Lea, 1937. 296 p. $2.75.

Biddle, Harry C. and Bush, George L. Dynamic Chemistry. Rand, 1936. 820 p. $1.80.

Black, Newton Henry, and Conant, James Bryant. New Practical Chemistry. Macmillan, 1936. 621 p. $1.80.

Brauer, Oscar L. Chemistry and Its Wonders. American, 1938. 760 p. $2.00.

Brownlee, Raymond B., Fuller, Robert W., Hancock, William J., Sohon, Michael, and Whitsit, Jesse E. First Principles of Chemistry. Allyn, 1937. 805 p.

Bruce, George H. High School Chemistry. World, 1938. 550 p. $1.68.

Dull, Charles E. Modern Chemistry. Holt, 1936. 745 p. $1.80.

Hogg, John C. An Introduction to Chemistry. Oxford, 1938. 288 p. $2.00.

Hopkins, B. S. et al. Chemistry and You. Lyons, 1939. 802 p. $1.80.

Horton, Ralph E. Modern Everyday Chemistry. Heath, 1937. 451 p. $1.68.

Howard, Russell S. Units in Chemistry. Holt, 1938. 756 p. $1.80.

Jaffe, Bernard. New World of Chemistry. Silver, 1937. 566 p. $1.80.

Kruh, Frank O., Carleton, Robert H., and Carpenter, Floyd F. Modern Life Chemistry. Lippincott, 1937. 734 p. $1.80.

Long, Ernestine M. J. Living Chemistry. Swift, 1935. 225 p. $1.00.

McPherson, William, Henderson, William Edwards, and Fowler, George Winegar. Chemistry at Work. Ginn, 1938. 672 p. $1.80.

Roberts, G. F. and Smith, H. C. Mastery Units in Chemistry. Colonial, 1936. 245 p. $0.67.

Wilson, Sherman R. Descriptive Chemistry. Holt, 1936. 312 p. $1.20.

——— Descriptive Chemistry and Physics. Holt, 1938. 356 p. $1.80.

F. PHYSICAL GEOGRAPHY AND GEOGRAPHY

Case, Earl Clark and Bergsmark, D. R. Modern World Geography. Lippincott, 1938. 746 p. $1.96.

Fletcher, Gustav. Earth Science. Heath, 1938. 568 p. $2.20.

Whitbeck, Ray H., Durand, Loyal, and Whitaker, Joe R. The Working World. American, 1937. 704 p. $2.20.

PART V

WORKBOOKS AND LABORATORY MANUALS

A. SENIOR SCIENCE

Bush, George L., Ptacek, Theodore W., and Kovats, J. John. Guided Activities in Senior Science. American, 1937. 251 p.

B. PHYSICS

Black, Newton Henry and Weaver, Elbert Cook. Laboratory Experiments and Workbook. Macmillan, 1938. 290 p. $1.00.

Cook, S. G. and Davis, Ira C. A Combined Laboratory Manual and Workbook in Physics. Mentzer, 1936. 238 p. $0.80.

Cushing, Burton A. A Laboratory Guide and Workbook. Ginn, 1937. 239 p. $0.76.

Fletcher, Gustav and Lehman, Sidney. Laboratory Manual for Unified Physics. McGraw, 1938. 210 p. $0.88.

Henderson, William D. Physics Guide and Laboratory Exercises. Lyons, 1936. 360 p. $1.00.

Fuller, Robert W., Brownlee, Raymond B., and Baker, D. T. Laboratory Exercises in Physics. Allyn, 1936. 299 p.

Petersen, Charles F. Fundamentals of Electricity. Bruce, 1936. 112 p. $0.96.

C. BIOLOGY

Adell, James C., Dunham, O. O., and Welton, L. E. Explorations in Biological Science. Ginn, 1938. 345 p. $1.12.

Blount, Ralph E. Workbook in Health. Allyn, 1938.

Craig, Edna and Stone, George K. Guide to High School Biology. Macmillan, 1938. 146 p. $0.96.

Davis, Roy E. and Davis, Ira C. A Combined Laboratory Manual and Workbook in Biology. Mentzer, 1937. 237 p. $0.80.

Downing, Elliot R. and McAtee, Vera. A Learning Guide in Biology. Lyons, 1936. 314 p. $0.80.

Hanger, Ernest O. and Lowe, Paul S. Directed Studies in Biology. Mentzer, 1937. 312 p. $0.96.

Harpster, E. E. Supplementary Studies in Nature Science. McKnight. Book I. 111 p. $0.48. Book II. 112 p. $0.48.

Van Aller, Holyer H. and Van Aller, Dorothy. General Biology Study Book. Globe, 1937.

Wood, George C. and Carpenter, Harry. Workbook for Our Environment: The Living Things In It. Allyn, 1938.

D. CHEMISTRY

Ames, Maurice U. and Jaffe, Bernard. Laboratory and Workbook Units in Chemistry. Silver, 1937. 255 p. $1.12.

Black, Newton Henry. New Laboratory Experiments in Practical Chemistry. Macmillan, 1936. 193 p. $1.20.

Brauer, Oscar L. Exploring the Wonders of Chemistry. American, 1938. 230 p. $0.48.

Conn, Kenneth E. and Briscoe, Herman T. A Combined Laboratory Manual and Workbook in Chemistry. Mentzer, 1935. 429 p. $0.80.

Hogg, John C. and Bickel, Charles L. Elementary Experimental Chemistry. Oxford, 1937. 288 p. $2.00.

Horton, Ralph E. Laboratory Manual in Chemistry. Heath, 1937. 99 p. $1.00.

Jones, J. Byron and Mathias, Louis J. Workbook and Laboratory Manual in Chemistry. College, 1937. 312 p. $0.96.

E. GENERAL SCIENCE

Curtis, Francis D. Workbook for Science for Today. Ginn, 1936. 197 p. $0.60.
Davis, Ira C. Directed Study Guide and Manual. Holt, 1936. 194 p. $0.60.
Davis, Jerome F., Hutchings, V. U., and Sharpe, C. P. A Directed Study Guide in General Science. College, 1938. 156 p. $0.53.
Painter, Donald H. and Skewes, George T. Directed Studies in General Science. Mentzer, 1937. 242 p. $0.80.
Powers, S. R., Neuner, Elsie F., and Bruner, Herbert B. Directed Activities II for This Changing World. Ginn, 1936. 125 p. $0.48.
——— Directed Activities III for Man's Control of His Environment. Ginn, 1936. 151 p. $0.48.
Teeters, William R., Bridges, Russell E., and Lee, William C. Workbook for Science at Work. Rand, 1936. 200 p. $0.64.
Watkins, Ralph K. and Bedell, Ralph C. Workbook for General Science Today. Macmillan, 1937. 144 p. $0.60.
Webb, Hanor A. and Beauchamp, Robert O. Workbook in General Science. Appleton, 1937. 312 p. $0.88.

JUNIOR HIGH SCHOOL

Arnold, E. Oren. Wild Americans. Whitman, 1938. 159 p. $1.50.
Atkinson, Agnes Akin. Skinny the Gray Fox. Viking, 1936. 111 p. $1.50.
——— Perkey. Viking, 1937. 100 p. $1.50.
Baruch, Dorothy and Reiss, Oscar. My Body and How It Works. Harper, 1938. $1.50.
Brindze, Ruth. Johnny Get Your Money's Worth. Vanguard, 1938. 230 p. $2.00.
Brownell, Clifford Lee, Ireland, Allen Gilbert, and Giles, Helen. Science in Our Lives. Rand, 1935. 248 p. $0.54.
——— Progress in Living. Rand, 1935. 264 p. $0.57.
Cannon, James L. Hoofbeats—Picture Book of Horses. Whitman, 1938. 48 p. $1.50.
Chapman, Wendell and Chapman, Lucie. Beaver Pioneers. Scribners, 1937. 167 p. $2.00.
Ditmars, Raymond L. The Book of Living Reptiles. Lippincott, 1936. 64 p. $2.00.
——— and Bridges, William. Wild Animal World—Behind the Scenes at the Zoo. Appleton, 1937. 302 p. $3.00.
Fenton, Carroll Lane. Life Long Ago. Reynal, 1937. 280 p. $3.50.
Eaton, Jeanette. The Story of Light. Harper, 1937. $1.25.
Ilin, M. Turning Night Into Day. A Story of Lighting. Lippincott, 1936. 119 p. $1.00.
Johnson, Gaylord. The Story of Earthquakes and Volcanoes. Messner, 1938. 144 p. $2.00.
King, Eleanor and Pessells, Wellmer. Insect People. Harper, 1938. 63 p. $1.25.
——— Insect Allies. Harper, 1938. 45 p. $1.25.
King, Julius. Mild Animals. Grosset, 1936. 39 p. $0.50.
Lathrop, Dorothy P. Animals of the Bible. Stokes, 1937. 69 p. $2.00.
Loewy, Raymond. Locomotive. Studio, 1937. $2.50.
Mannix, Daniel P. More Backyard Zoo. Coward, 1936. 252 p. $2.00.
Olcott, Frances Jenkins. Our Wonderful World. Brown, 1935. 299 p. $2.50.
Peattie, Donald C. A Child's Story of the World. Simon, 1937. 148 p. $2.00.
Pigman, Augustus. A Story of Water. Appleton, 1938. 151 p. $1.50.
Stowell, Thora and Burgess, Thornton W. The Book of Animal Life. Brown, 1937. 315 p. $2.50.
Symposium. National Health Series. Funk, 1937. $0.35 each.
Bigelow, Maurice. Adolescence.
Gillett, Lucy H. Food for Health's Sake.
Hart, T. Stewart. Taking Care of Your Heart.
Kleinschmidt, H. E. Tuberculosis.
Laird, Donald. How To Sleep and Rest Better.
Lewis, F. Park. What You Should Know About Eyes.
Miner, Leroy. Why the Teeth.
Rice, Thurman B. The Human Body.
Rowell, Grant. Hear Better.
Smillie, W. G. The Common Cold.
Snow, William. Venereal Disease.
Tobey, James A. The Common Health.
Williams, Jesse F. Exercise and Health.
Wood, Frances. Cancer.
Verrill, A. Hyatt. Strange Insects and Their Stories. Page, 1937. 201 p. $2.50.
Wilhelm, Donald. The Story of Iron and Steel. Harper, 1937. 109 p. $1.25.
W.P.A. Project. Birds of the World. Whitman, 1938. 205 p. $1.75.
——— Who's Who in the Zoo. Whitman. $1.75.
Yates, Raymond F. How To Make Electric Toys. Appleton, 1937. 199 p. $2.00.

ELEMENTARY SCIENCE

A. PRIMARY GRADES

Austin, F. E. Little Sammy Cricket. Austin, 1937. 55 p. $0.25.
Dubois, Gertrude and Frances. Peter and Penny Plant a Garden. Stokes, 1937. 207 p. $1.25.
Frasier, George Willard, Dolman, Helen, and Van Noy, Kathryne. We See. Singer, 1937. 32 p. $0.20.
——— Sunshine and Rain. Singer, 1937. 64 p. $0.72.
——— Through the Year. Singer, 1937. 160 p. $0.72.
——— Winter Comes and Goes. Singer, 1938. 224 p. $0.84.
Harter, Helen and McIntire, Olla. Food. Follett, 1936. $2.95 (set).
——— How We Travel. Follett, 1936. 31 p. $0.50.
Kane, Henry B. The Alphabet of Birds, Bugs and Beasts. Houghton, 1938. $1.50.

Keith, Linton V. Coal. Follett, 1937. 40 p. $0.15.

Kipling, Rudyard. Animal Stories. Doubleday, 1938. 199 p. $2.50.

Masters, Kathrine. The Pet Club. Heath, 1937. 223 p. $0.92.

McIntire, Alta. Milk. Follett, 1936. $0.50.

Myers, Emma. Pets and Friends. Heath, 1937. 86 p. $0.84.

Sondergaard, Areusa. Fuzzy Tail. Heath, 1937. 123 p. $0.72.

Symposium. Unit Study Readers. Education. $0.15 each.

FIRST GRADE

Freeland, Isabelle V. Animal Families.
Johnson, Eleanor M. Travel.
Policemen.
Firemen.
Keeping Our City Safe and Clean.
The Dairy.
Farm Animals.
Pets.
The Circus.
Our Houses.
The Library.
McCroy, Mae. How Animals Travel.
McDonough, Reata D. Birds and Their Babies.
Summy, Ethel I. The Zoo.
Withrow, Vesta. The Story of Seeds.

SECOND GRADE

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McCroy, Mae. The Story of Milk.
Plants That Give Us Food.
Clothes.
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Early Man and Animals.
Smith, Jeanette. Sun, Moon and Stars.
Simple Machines.
Animals and Their Babies.

THIRD GRADE

Alder, Grace. The Seasons.
Bigler, Marguerite. Navajo Indians.
Cooper, Helen M. Glass and Bricks.
Davis, Gaynelle. Protection in Nature.
Herring, Mary Belle. The Story of Frogs.
Hill, Claude R. How Birds Live.
Howard, Ethel K. Coal.
Hurley, Beatrice J. Trains.
The Story of Flying.
The Story of Boats.
Klaussen, Doris D. The Story of Heat.
Lacy, Frances. What Animals Eat.
O'Keefe, Ida Ten Eyk. Forest Indians.
Smith, Jeanette. Pets at School; Our Vivarium.
Wheeler, Marian S. Paper.

Tippett, James S. and Tippett, Martha Kelly. Sniff. Heath, 1937. 183 p. $0.80.

B. INTERMEDIATE GRADES

Athey, Lillian Cox. Along Nature's Trail. American, 1936. 338 p. $1.20.

Bailey, Bernardine and Selover, Zabeth. Cave, Castle and Cottage. Follett, 1937. 96 p. $1.13.

Beaty, John. Story Pictures of Our Neighbors. Beckley, 1938. 191 p. $0.80.

——— Trees. Donahue, 1938. 96 p. $1.50.

——— Story Pictures of Farm Work. Beckley, 1936. 128 p. $0.70.

Beauchamp, Wilbur L., Fogg, Harriet M., Crampton, Gertrude, and Gray, Wm. S. Science Stories Book III. Reilly, 1937. 256 p. $1.25. or Scott, 1936. $0.80.

Beauchamp, Wilbur L., Melrose, Mary, and Bough, Glenn O. Discovering Our World Book I. 1937. 288 p. $0.88. Book II, 1938. 352 p. $0.96. Scott.

Bronson, Wilfrid S. The Wonder World of Ants. Harcourt, 1937. 87 p.

Brownell, Clifford Lee, Ireland, Allen Gilbert, and Giles, Helen Fisher. Everyday Living. Rand, 1935. 218 p. $0.45.

——— Helpful Living. Rand, 1935. 232 p. $0.48.

Clarke, Frances and Keelor, Katherine L. Our Town and City Animals. Heath, 1937. 218 p. $0.76.

Edwards, Paul G. and Sherman, James W. Earth and Sky (IV). Brown, 1937. 278 p. $0.92.

Graham, Wayne O. and James. Forest Families. Brown, 1937. 315 p. $0.96.

Keelor, Katherine L. On Uncle Charlie Clarke's Farm. Heath, 1937. 196 p. $0.72.

McKay, Herbert. Air, Wind and Rain. Oxford, 1938. 48 p. $0.80.

——— Looking Glasses and Candles. Oxford, 1938. 56 p. $0.80.

——— Noises; The Sun and Moon. Oxford, 1938. 62 p. $0.80.

McIntyre, Flora. Children of the Golden Queen. Dutton, 1938. 80 p. $1.50.

Patch, Edith M. and Fenton, Carroll Lane. Desert Neighbors. Macmillan, 1937. 170 p. $1.75.

——— Mountain Neighbors. Macmillan, 1936. 156 p. $1.50.

Petersham, Maud and Miska. The Story of Aircraft. Winston, 1936. 32 p. $0.60.

——— The Story Book of Wheat. Winston, 1936. 31 p. $0.60.

Phillips, Mary G. and Wright, Julia M. Nature by Seaside and Wayside. Heath. $0.64 to $.72 each.
Book I. Some Animals and Their Homes. 142 p.
Book II. Some Animal Neighbors. 186 p.
Book III. Plants and Animals. 244 p.
Book IV. Our Earth and Its Life. 280 p.

Porter, Walter P. and Hansen, Einar A. The Pond Book. American, 1936. 210 p. $0.88.
——— Fields and Fencerows. American, 1937. 274 p. $0.80.
Robinson, W. W. Lions. Harper, 1938. $1.75.
Shakelford, Shelby. Now for Creatures. Scribners, 1936. 130 p. $2.00.
Symposium. Unit Study Readers. Education. $0.15 each.

FOURTH GRADE

Fee, Walter R. and Violet. Greeks.
Egyptians.
The Romans.
Greenwood, Thelma. Indoor Gardens.
Greve, Anna M. Soil: Its Sources and Uses.
Howard, Ethel K. Time.
Nilsson, Kristin. Water.
Ousley, Odillie. Hot, Dry Lands.
Philbrick, Meta G. Magnetism and Electricity.
Raferty, Gerald. Vikings.
Reed, Edna. Beginnings of Trade.
Strickland, Ruth G. Bees and Ants.
Van Amburgh, Della. Silk.
Light.
Communication.

FIFTH GRADE

Almack, John C. The Story of Knighthood.
Cooke, Tolosa. Corn.
Fee, Walter R. and Violet. The Winning of the West.
Greenleaf, Dorothy. Growth of Cities.
Hurtebise, Alida. The Story of Irrigation.
Johnson, Marie Ellen. Rubber.
Klaussen, Doris D. Early Explorers.
Marks, Sallie B. Cotton.
Trowbridge, Lydia J. Transportation.
Van Amburgh, Della. Colonial Life.

SIXTH GRADE

Almack, John C. Homes, Old and New.
Fee, Walter R. and Violet. Japan Today.
Grenzow, Daisy. World Trade.
Howard, Ethel K. Lumber.
Hurtebise, Alida. Inventions.
Klaussen, Doris D. Modern Explorers.
Sager, Martha F. Newspapers.
Thomas, Eleanor H. The Story of Money.
Trowbridge, Lydia. Cereals.
Tutt, Clara L. Fisheries.
Tippett, James S. Paths to Conservation. Heath, 1937. 299 p. $0.88.
Webster, Hanson Hart and Polkinghorn, Ada R. What the World Eats. Houghton, 1938. 380 p. $2.00.
Wells, Harrington. Seashore Life. Wagner, 1937. 271 p. $1.25.
Wheat, Frank M. and Reh, F. Science and Life. Book V. American, 1938. $1.16.
Whitnal, Harold O. A Parade of Ancient Animals. Crowell, 1936. 135 p. $2.00.

LIST OF PUBLISHING FIRMS

Allyn. Allyn and Bacon. 50 Beacon St., Boston, Mass.
Agriculture. U. S. Department of Agriculture. Washington, D. C.
American. American Book Company. 88 Lexington Ave., New York, N. Y.
Appleton. D. Appleton-Century Company. 35 W. 32nd St., New York, N. Y.
Austin. The Austin Workshop. Hanover, New Hampshire.
Beckley. Beckley-Cardy Company. 1632 Indiana Ave., Chicago, Ill.
Blakiston. P. Blakiston's Son and Company. 1012 S. Walnut St., Philadelphia, Pa.
Blue. Blue Ribbon Books. 386 Fourth Ave., New York, N. Y.
Bobbs. Bobbs-Merrill Company. Indianapolis, Ind.
Bradner. The Bradner Publishing Company. Cambridge, Mass.
Brown. Little, Brown and Company. 34 Beacon St., Boston, Mass.
Bruce. Bruce Publishing Company. 524 N. Milwaukee St., Milwaukee, Wis.
Bureau. Bureau of Publications, Teachers College, Columbia University. New York, N. Y.
California. Southern California School Book Depository. 3636 Beverly Blvd., Los Angeles, California.
Carnegie. Carnegie Foundation for Advancement of Teaching. 522 Fifth Ave., New York, N. Y.
Caxton. Caxton Printers Ltd. Caldwell, Idaho.
Chemical. Chemical Publishing Company of New York. 148 Lafayette St., New York, N. Y.
Chicago. Chicago University Press. 5750 Ellis Ave., Chicago, Ill.
Christopher. Christopher Publishing House. 1140 Columbus Ave., Boston, Mass.
Clark. Elsa Clark. Enoch Pratt Free Library, Baltimore, Md.
Cokesbury. Cokesbury Press. 810 Broadway, Nashville, Tenn.
College. College Entrance Book Company. 104 Fifth Ave., New York, N. Y.
Columbia. Columbia University Press. Columbia University, New York, N. Y.
Comstock. Comstock Publishing Company. Cornell Heights, Ithaca, N. Y.
Covici. Covici-Friede, Inc. 435 E. 24th St. New York, N. Y.
Coward. Coward McCann. 55 Fifth Ave., New York, N. Y.
Crowell. Thomas Y. Crowell Company. 393 Fourth Ave., New York, N. Y.
Darwin. The Darwin Press. New Bedford, Conn.
Dickster. M. Richard Dickster. 2313 Seventy-Sixth Ave., Philadelphia, Pa.
Dodd. Dodd, Mead and Company. 443 Fourth Ave., New York, N. Y.

Dodge. Dodge Publishing Company. 116 East 16th St., New York, N. Y.
Donohue. M. A. Donohue and Company. 711 S. Dearborn Ave., Chicago, Ill.
Dorrance. Dorrance and Company. 364–376 Drexel Bldg., 5th and Chestnut Sts., Philadelphia, Pa.
Doubleday. Doubleday, Doran and Company. 14 West 49th St., New York, N. Y.
Dutton. E. P. Dutton Company. 286 Fourth Ave., New York, N. Y.
Education. American Education Press, Inc. 400 South Front St., Columbus, Ohio.
Edwards. Edwards Brothers. Ann Arbor, Mich.
Emerson. Emerson Books, Inc. 251 W. 19th St., New York, N. Y.
Falk. Falk Publishing Company. 10 W. 33rd St., New York, N. Y.
Farrar. Farrar and Rinehart. 232 Madison Ave., New York, N. Y.
Follett. Follett Publishing Company. 1255 S. Wabash Ave., Chicago, Ill.
Folmer. The Folmer Graflex Corporation. Rochester, N. Y.
Fomo. Fomo Publishing Company. 3111 Tuscarawas St. W., Canton, Ohio.
Forestry. American Forestry Association. 919 17th St. N. W., Washington, D. C.
Funk. Funk and Wagnalls. 354 Fourth Ave., New York, N. Y.
Galleon. Galleon Publishers, Inc. 100 Fifth Ave., New York, N. Y.
Garden. Garden City Publishing Company. 14 West 49th St., New York, N. Y.
Garrard. Garrard Press. 119 W. Park Ave., Champaign, Ill.
Geographic. The National Geographic Society. 16th and Main Sts. N. W., Washington, D. C.
Ginn. Ginn and Company. 15 Ashburton Place, Boston, Mass.
Globe. Globe Book Company. 175 Fifth Ave., New York, N. Y.
Glyco. Glyco Products Company, Inc. 148 Lafayette St., New York, N. Y.
Greenburg. Greenburg, Publisher. 67 W. 44th St., New York, N. Y.
Gregg. The Gregg Publishing Company. 6 North Michigan Ave., Chicago, Ill.
Grosset. Grosset and Dunlap. 1107 Broadway, New York, N. Y.
Halcyon. Halcyon House Publications. 386 Fourth Ave., New York, N. Y.
Hale. Hale, Cushman and Flint. 116 Newbury St., Boston, Mass.
Harcourt. Harcourt, Brace and Company. 383 Madison Ave., New York, N. Y.
Harlow. Harlow Publishing Company. 217 N. Harvey St., Oklahoma City, Okla.
Harper. Harper and Brothers. 49 E. 33rd St., New York, N. Y.
Heath. D. C. Heath Company. 285 Columbus Ave., Boston, Mass.
Hillman. Hillman-Curl, Inc. 7 E. 44th St., New York, N. Y.
Holt. Henry Holt and Company. 2626 Prairie Ave., New York, N. Y.
Houghton. Houghton, Mifflin and Company. 2 Park St., Boston, Mass.
Humphries. Bruce Humphries, Inc. 306 Stuart St., Boston, Mass.
Instruction. State Department of Public Instruction. Des Moines, Iowa.
International. International Textbook Company. Scranton, Pa.
Jaques. H. E. Jaques. Mt. Pleasant, Iowa.
Knight. Knight Publishers. 432 Fourth Ave., New York, N. Y.
Knopf. Alfred A. Knopf. 501 Madison Ave., New York, N. Y.
Lea. Lea and Febiger. 600 S. Washington Square, Philadelphia, Pa.
Lippincott. J. B. Lippincott Company. 220 North Michigan Ave., Chicago, Ill.
Longmans. Longmans, Green and Company. 114 Fifth Ave., New York, N. Y.
Lyons. Lyons and Carnahan. 76 Ninth Ave., New York, N. Y.
Macmillan. The Macmillan Company. 60 Fifth Ave., New York, N. Y.
McBride. Robert M. McBride and Company. 4 West 16th St., New York, N. Y.
McFarlane. McFarlane, Warde and McFarlane. 6 East 45th St., New York, N. Y.
McGraw. McGraw-Hill Book Company. 330 W. 42nd St., New York, N. Y.
McKnight. McKnight and McKnight. Bloomington, Ill.
Mentzer. Mentzer, Bush and Company. 2210 South Parkway, Chicago, Ill.
Messner. Julian Messner, Inc., Publishers. 8 West 40th St., New York, N. Y.
Minnesota. University of Minnesota Press. Minneapolis, Minn.
Modern. Modern Age Book Service. 155 East 44th St., New York, N. Y.
Morrow. Wm. Morrow and Company. 386 Fourth Ave., New York, N. Y.
Morgan. Morgan and Lester, Publishers. 100 East 42nd St., New York, N. Y.
Mosby. C. V. Mosby Company. 3523 Pine Blvd., St. Louis, Mo.
Murray. John Murray. Albemarle Street, W. London, England.
Nature. American Nature Association. Washington, D. C.
Nelson. Thomas Nelson and Sons. 381 Fourth Ave., New York, N. Y.
Newman. Hugh F. Newman Company. Los Angeles, California.
Newson. Newson and Company. 72 Fifth Ave., New York, N. Y.
North Carolina. University of North Carolina Press. Chapel Hill, N. Carolina.
Norton. W. W. Norton and Company. 70 Fifth Ave., New York, N. Y.
Oklahoma. Oklahoma University Press. Norman, Oklahoma.

Orange. Orange Judd Publishing Company. 15 E. 26th St., New York, N. Y.
Oxford. Oxford University Press. 114 Fifth Ave., New York, N. Y.
Page. L. C. Page and Company. 53 Beacon St., Boston, Mass.
Palisade. Palisade Press. 280 Broadway, New York, N. Y.
Photographic. American Photographic Publishing Company. 353 Newbury St., Boston, Mass.
Pitman. Pitman Publishing Corporation. 2-6 W. 45th St., New York, N. Y.
Porter. The Porter Chemical Company. Hagerstown, Md.
Prentice. Prentice Hall, Inc. 70 Fifth Ave., New York, N. Y.
Princeton. Princeton University Press. Princeton, N. J.
Putnam. G. P. Putnam's Sons. 2 West 45th St., New York, N. Y.
Rand. Rand McNally and Company. 536 S. Clark St., Chicago, Ill.
Reilly. Reilly and Lee Company. 325 W. Huron St., Chicago, Ill.
Reinhold. Reinhold Publishing Corporation. 330 W. 42nd St., New York, N. Y.
Research. Research Publishers. Scranton, Pa.
Reynal. Reynal and Hitchcock. 386 Fourth Ave., New York, N. Y.
Rubber. The Chemical Rubber Company. Cleveland, Ohio.
Sanborn. Benj. H. Sanborn and Company. 221 East 20th St., Chicago, Ill.
Saunders. W. B. Saunders Company. W. Washington Square, Philadelphia, Pa.
Scott. Scott, Foresman and Company. 623 S. Wabash Ave., Chicago, Ill.
Scribners. Charles Scribner's Sons. 597 Fifth Ave., New York, N. Y.
Scripture. The Scripture Press. 800 N. Clark St., Chicago, Ill.
Silver. Silver, Burdett and Company. 45 E. 17th St., New York, N. Y.
Simon. Simon and Schuster. 386 Fourth Ave., New York, N. Y.
Singer. The L. W. Singer Company. 249 W. Erie Blvd., Syracuse, N. Y.
Skewes. George Skewes. State Teachers College, Mayville, North Dakota.
Smith. W. Hazelton Smith. 37 Franklin St., Buffalo, N. Y.
Stanford. Stanford University Press. Stanford University, California.
Steck. Steck Company Publishers. Austin, Texas.
Stokes. Frederick A. Stokes. 443 Fourth Ave., New York, N. Y.
Studio. Studio Publications. 381 Fourth Ave., New York, N. Y.
Swift. John S. Swift and Company. 105 S. 9th St., St. Louis, Mo.
University. University Society. 468 Fourth Ave., New York, N. Y.
Vanguard. Vanguard Press. 424 Madison Ave., New York, N. Y.
Van Nostrand. D. Van Nostrand Company. 250 Fifth Ave., New York, N. Y.
Viking. Viking Press. 18 E. 48th St., New York, N. Y.
Wagner. Harr Wagner Publishing Company. 609 Mission St., San Francisco, California.
Warne. Frederick Warne and Company. 381 Fourth Ave., New York, N. Y.
Webb. Hanor A. Webb. George Peabody College for Teachers, Nashville, Tenn.
Webster. Webster Publishing Company. 1808 Washington Ave., St. Louis, Mo.
Whitman. Albert Whitman and Company. 560 W. Lake St., Chicago, Ill.
Whittlesey. Whittlesey House. 330 W. 42nd St., New York, N. Y.
Wiley. John Wiley and Sons, Inc. 440 Fourth Ave., New York, N. Y.
Wilkins. Williams and Wilkins. Mt. Royal and Guilford Aves., Baltimore, Md.
Wilson. H. W. Wilson Company. 950 University Ave., New York, N. Y.
Winston. John C. Winston Company. 629 S. Wabash Ave., Chicago, Ill.
Wise. Harold E. Wise. Teachers College, University of Nebraska, Lincoln, Nebraska.
Woman. The Woman's Press. 600 Lexington Ave., New York, N. Y.
Wood. William Wood and Company. Mt. Royal and Guilford Aves., Baltimore, Md.
World. World Book Company, Yonkers, N. Y.
Yale. Yale University Press. New Haven, Conn.

Classroom Notes

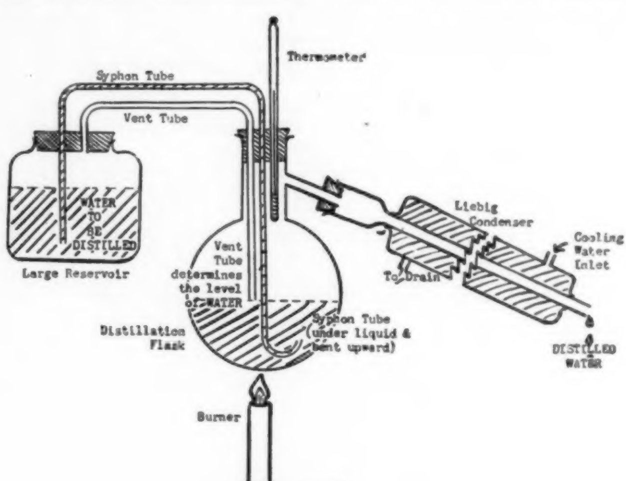
A Distillation Apparatus that May Test Pupil Observation.—Many small private laboratories operated by students in their basements and attics as well as the laboratories in the small high schools lack the facilities for providing enough distilled water when needed. Commercial types of equipment are usually considered too expensive and many think that distilled water is needed so seldom that one can just as well prepare it with a distillation flask and Liebig condenser, when the need arises. It should be unnecessary to point out that when that time comes, one usually finds that the apparatus is not only painfully slow but most important of all, it demands constant attention for refilling.

Many instructors pass up the opportunity to use their laboratory equipment for anything except that for which it was technically designed. To educators, every commercial piece of apparatus as well as each home made contrivance should suggest a tool that each might economically use in his teaching. This distillation apparatus should not only prove valuable to the analyst interested in obtaining distilled water but also to the teacher.

Apparatus, similar to the one about to be described, may be in use in other schools and laboratories other than here at the University of Minnesota High School. In fact, it would be surprising indeed, if such were not the case for the principle is extremely simple. It merely consists, as the diagram shows, of the traditional distillation flask and appropriately connected Liebig condenser, plus a large reservoir for supplying extra water, as the distillation process proceeds. Many may have tried the system of letting a stream of water constantly drip into the flask, planning in this way to compensate for the loss by boiling. They may also have had the misfortune of finding that it is practically impossible to gauge that rate and equally difficult to keep each of these rates equal for long.

This same reservoir idea with the plan for controlling the syphon and hence the water level in the flask, may have occurred to many. Probably, some have attempted to build one only to find that something about it kept it from working as he had expected. In that case, perhaps the reservoir with its regulated syphon has either been disregarded or left standing unused. For those, it may be interesting to know that there are one or two things that can either allow it to work or make it useless.

The accompanying diagram explains the design of this apparatus. After the syphon tube is filled, the water will run down into the flask from the reservoir, only when the vent tube is open. One might expect that the syphon tube need merely be long enough so that it extends to a level lower than the lowest height of the water in the reservoir. That in itself should be



sufficient for a syphon. In fact, it would be a bit more interesting for those watching its operation, if that tube did not extend into the liquid of the distillation flask, for then it would let its deposit of water visibly pour in, from time to time. However, that type of a set up will not work well. After making it in that incorrect

way, one will notice that the syhon breaks after each addition of water. The reason for this becomes apparent when one notices that the entering water attains a bit of inertia in flowing and when the level approaches the vent tube, the water is pulled up into the tube. In fact, it is pulled up in an effort to compensate for the difference in level between that in the reservoir and that in the flask. In being equalized, it pumps air into the reservoir and empties an extra portion of water into the flask. That in itself does no harm, but then when the liquid which has climbed into the vent tube falls again, it sucks the syphon tube dry. That is the reason that both ends of the syphon tube must be under water. It is just as well that the syphon tube be bent either to the side or upwards because otherwise, the convection currents within the boiling liquid will somewhat hamper the direction of flow.

The bubbling of the boiling water and the intermittent flow of water from the reservoir leaves liquid in the vent tube from time to time. This does no harm if the syphon tube has been placed under the surface, but one will notice that there is a tendency for much of the water in the distillation flask being driven up into the reservoir. This has its advantage for in that way, while it is imitating a modified hot water heating plant, it is also heating up the reservoir water. That is advantageous because after the whole system becomes warm, each addition of water from the reservoir will not cool the flask sufficiently to stop the boiling process.

Whenever a piece of equipment utilizes principles that are simple, it is well to make use of that apparatus in every way possible. For example, this syphon-regulated-distillation apparatus can save much time and attention on the part of the instructor and experimenter. However, the usefulness of equipment should be partly dependent upon its application to demonstration. In the classroom, class laboratory, or lecture demonstration, one should use every opportunity to show the pupils practical applications of these principles and also to test them for their accuracy of observation and reasoning. Even if this apparatus merely worked in a flawless manner, it would still serve as an excellent basis for a test of pupil observation and his understanding of principles already explained. In this particular case, the fact remains that not every type of syphon system would work in this apparatus and it would present an even better opportunity for the instructor to test his pupils on their understanding of these principles and also their ability to "trouble shoot" the reason for one method not working properly.

Shailer A. Peterson,
University of Minnesota.

Abstracts

SECONDARY SCIENCE

EBEL, ROBERT L. "Atomic Structure and the Periodic Table." *Journal of Chemical Education* 15 : 575–577; December, 1938.

The purpose of this article is to suggest a way in which the periodic table and its interpretation may be clarified by closer correlation with the fundamental concepts of atomic structure. A most useful periodic table is presented which eliminates the complications of long periods and rare earths.

—C.M.P.

MEISTER, MORRIS. "Simple Apparatus—Difficult Ideas." *The Science Classroom* 18 : 1; January, 1938.

"A large part of the science teacher's job is to help the pupil to understand new ideas. Sometimes these ideas are easily grasped; at other times the teacher's efforts are met with that vague, puzzled look in the pupil's eye which indicates lack of comprehension. Under such circumstances the beginning teacher falls back upon repetition; he goes over the ground once more. Often his voice grows louder, rising in pitch. Eventually, such a teacher becomes impatient, helpless, and hopeless. Those of us who in supervisory capacity have had occasion to witness these inept struggles between inexperienced teaching and puzzled young minds, realize how unnecessary and wasteful is the time and effort spent. As we observe, in contrast, the experienced and successful teacher, we see at once that two principles are at the basis of an artistic performance in the science classroom.

First, is the fact that difficult ideas are prepared for. Preliminary ideas are presented. They are arranged in carefully thought out sequence. Necessary building stones are put in their proper places so that the mental climb toward complete understanding will be gradual and secure.

Second, is the utilization of simple, objective materials, with which the pupil is already familiar, and which are cleverly arranged to illustrate the ideas in an ascending and climatic sequence."

—C.M.P.

MITCHELL, WESLEY C. "Science and the State of Mind." *Science* 89 : 1–4; January 6, 1939.

This is the address of the President of the American Association for the Advancement of Science given at the luncheon of the American Science Teachers Association, Richmond, Virginia, December 29.

The thing that characterizes all true scientists are their single-mindedness in the search for truth. They avoid wishful thinking and do not alter their findings to suit non-scientific beliefs or longings or dislikes of others or themselves. There are both inner and outer obstacles in living up to the ideal—it is so difficult to maintain a strictly scientific attitude in all relations of life. Progress in human well-being is conditioned by progress in discovery in both the natural and the social sciences.

—C.M.P.

ADAMS, C. S. "Some Experiences in Teaching General Chemistry for its Cultural Value." *Journal of Chemical Education* 15 : 415–419; September, 1938.

The author states the case for a special course in general chemistry for the non-professional or liberal arts student. A matter and energy course given in Antioch College was discontinued in 1936 and now two separate courses in physics and chemistry are required of arts students.

—C.M.P.

COOKE, ROBERT LOCKE. "Demonstration versus Laboratory Once Again." *Journal of Chemical Education* 15 : 592–594; December, 1938.

This article describes a teaching technique successfully used in several California high schools. It seems to eliminate many of the disadvantages of teacher demonstrations or pupil individual laboratory work. The procedure consists of a rotation technique whereby two pupils demonstrate the experiment. Each pair of pupils demonstrate the experiment. Each pair of pupils demonstrate from five to eight experiments during the year.

—C.M.P.

ABBOTT, HOWARD C. "Student Equipment in Biology Classes." *Biology Briefs* 1 : 59–60; November, 1938.

The author presents reasons for having school-owned dissecting sets for each individual pupil in the biology laboratory. A laboratory breakage deposit would take care of individual breakage in the laboratory.

—C.M.P.

ANONYMOUS. "Animated Biology." *Biology Briefs* 1 : 69; December, 1938.

This is a description of the equipment and activities in a biology room of the Von Steuben High School of Chicago. There are an unusually large number of small aquariums and terrariums.

—C.M.P.

ANONYMOUS. "Insects." *The Science Leaflet* 12: 19–24; December 15, 1938.

This article discusses the following topics: (1) What are insects?, (2) Comparisons of insects and vertebrate animals, (3) Internal features of insects, (4) Senses of insects, (5) Growth of insects differ from that of vertebrates, (6) Reproduction among insects, (7) Social insects, (8) Insect intelligence, (9) Relations of insects, (10) Other classes related to the insects, and (11) The future of insects.

—C.M.P.

GOODRICH, ORA. "The New Food, Drug and Cosmetic Act; Plan for a Unit of Work on Cosmetics." *The Science Leaflet* 12: 30–36; December 6, 1938.

The first article summarizes the provisions of the new Food, Drug, and Cosmetic Act of June 25, 1938. The second article outlines a unit for study on cosmetics for a high school science class.

—C.M.P.

ORNFORFF, F. C. "Some Supplementary Materials for the Teaching of Biology." *The Iowa Science Teacher* 4: 112–119; December, 1938.

This article gives a list of materials available to biology teachers on such topics as: (1) birds, (2) conservation, (3) foods, including diet and digestion, (4) forestry, (5) fungi, (6) health, (7) insects, (8) narcotics, (9) plant cultivation, (10) soil, (11) heredity, and (12) miscellaneous.

—C.M.P.

WAILES, RAYMOND B. "Gas Experiments for Home Experimenters." *Popular Science Monthly* 134: 192–195, 232; January, 1939.

Interesting experiments on generating ethylene gas and showing its properties are described.

—C.M.P.

WALLING, MORTON C. "Marvels in Common Foods." *Popular Science Monthly* 134: 198–201, 234; January, 1938.

This article describes interesting microscopic experiments with sugar, onion cells, celery cells, yeast and bacteria.

—C.M.P.

SYMPOSIUM. "Clothing." *Science Leaflet* 12: 522–541; January 5, 1939.

Several excellent articles on textile fabrics are included in this symposium. The flowsheets of four main processes for making rayon are especially good.

—C.M.P.

WAILES, RAYMOND B. "Home Tests with Dry Ice." *Popular Science Monthly* 134: 208–211, 250; February, 1938.

This article describes some very interesting experiments with dry ice.

—C.M.P.

SCIENCE

POLAKOV, WALTER N. "The Unemployment of Technology." *The Social Frontier* 5: 73–75; December, 1938.

Our much-bragged-about standard of living at 1929 was far more imaginary than real. We then produced far below our actual needs. The author maintains and proves conclusively that much of our present unemployment is due to: technological developments accompanied by our general inability to think the problem through to its ultimate conclusion. On the average a million dollars worth of labor saving machinery displaces permanently about a thousand workers. A manufacturer can pay a 1,000 workers at $1,000 each for a year and reduce employment in the following years by 500 annually—showing a profit of $500,000 to the employer. Thus, improvements in 1936–37 resulted in the depression of 1938. The output of 1929 produced by 17,500,000 workers would need only 12,300,000 workers in 1938.

The technology of mass production in our competitive society has reached a point where it begins to defeat itself. We face a dilemma: either to break the fetters of competitive restrictions and to employ technology and men to produce plenty for all; or else to suppress technology, degenerate men and destroy civilization.

—C.M.P.

BROGDEN, STANLEY. "Superstition Is Returning." *Discovery* 1: 403–406; November, 1938.

The author maintains that there is increase in superstition, basing his reason on the increase in interest in astrology in England and the United States. Four of eight morning newspapers published in London have daily horoscopes. It is estimated that every person in the United Kingdom has access to a horoscope from the press.

The author says, "The grip of the astrologer upon the American mind cannot be grasped by those who have not studied it first hand. To millions of Americans, hard bitten business men as well as neglected housewives, the influence of the stars is a living thing. More than a dozen magazines devoted to astrology have gained large circulations—not one wireless listener in the United States need pass a day without turning on an astrological forecast! The United States and the United Kingdom need to ban such forecasts by law."

—C.M.P.

SCHLAIKJER, ERICH M. "The Road to Man." *Natural History* 42: 212–222; October, 1938.

An unusually good chart with description, tracing man's development from the first vertebrates 450 million years.

—C.M.P.

ANONYMOUS. "Air Records Near Limit." *Science News Letter* 35: 12; January 7, 1939.

During the past 35 years record-seeking airmen have pushed altitude, range and speed records steadily upward but are nearing the limits with present type planes. The records are: for height, 56,000 feet; for range, 7,000 miles, and for speed 440.8 miles per hour. Limits are believed to be about 60,000 feet for altitude, 8,000–9,000 miles for range, and 500 miles an hour speed.

—C.M.P.

KAEMPFFERT, WALDEMAR. "Life on Other Planets?" *Science Digest* 4: 66–70; October, 1938.

This article is condensed from *The New York Times Magazine*. The question of life on other planets has long intrigued the minds of man. Only two planets, Venus and Mars, have a possibility of life. The atmosphere of Venus is so heavy that the surface temperature probably reaches the temperature of boiling water. No fire could burn on Venus, and no plant or animal life could exist. As for Mars only a very low type of plant life is considered at all possible.

—C.M.P.

RUSSELL, HENRY N. "Inside the Great Planets." *Scientific American* 159: 294–295; December, 1938.

Recent evidence indicates larger amounts of hydrogen in the atmospheres of the major planets than formerly assumed. Methane and ammonia have been proved definitely as constituents of Jupiter, Saturn, Uranus and Neptune. Liquid hydrogen under great pressure surrounds these planets. The minor planets have a core of iron and granite.

—C.M.P.

ANONYMOUS. "Direct Current Super-Power." *Scientific American* 159: 305; December, 1938.

High tension D. C. transmission may come soon if the development of tubes similar to those used in radio fulfill expectations. Alternating current would be stepped up to a high voltage, converted into D. C. by the tube rectifier, then re-converted to alternating current at the point of use. A. C. transmission involves greater loss of power and the distance limit seems to be about 300 miles. A two-wire D. C. line will deliver 43 per cent more power than present 3-wire A. C. lines using the same size conductor and the same insulation. Long distances make the advantages still greater. With the development of satisfactory tube rectifiers it will be possible to transmit current from the Columbia River to Chicago and even New York at a cost lower than that at present.

—C.M.P.

NEWMAN, BARCLAY M. "Must We Grow Old." *Scientific American* 159: 285–288; December, 1938.

Laboratory research by noted scientists give ground for some hope that old age may be forestalled, and that we may even live eternally. The bases for these hopes are presented in this article.

—C.M.P.

STEFANSSON, VILHJALMUR. "The Disappearance of the Greenland Colony." *Natural History* 33: 7–12, 34–37; January, 1939.

Under the leadership of Erik the Red a colony of Norwegians was established in Greenland in 986. This colony swelled to 9,000 souls and helped support the Crusades. Then the colony mysteriously disappeared. The last contact with Europe was made in 1410 or 1448. The colony was a republic from 990 to 1261—a total of 271 years. Then it became affiliated politically as a province of Norway. Most investigators have believed the colony became extinct, but more recent evidence lends some support to the belief that the colonists really became absorbed by the Eskimos through intermarriage.

—C.M.P.

PATTER, ROBERT. "Use of a Diamond in Research." *Science News Letter* 34: 325–326; November 19, 1938.

A flawless four thousand dollar diamond has had one of its largest surfaces ground smooth to about one five hundred-thousandth of an inch for use in "probing the fundamental constants of the physical world" at the Johns Hopkins University. Prof. J. A. Bearden is using this gem and X-ray beams as a means of redetermining the e/m constant. Just as many independent determinations of Avogadro's number, N, has added to the confidence of scientists in its certainty so divergent approaches to the value of the above mentioned constant gives greater certainty of its correctness.

—B. C. Hendricks.

STAFFORD, JANE. "Life Giving Dye." *Science News Letter* 34: 362–363; December 3, 1938.

"Fourteen major victories over disease within three years—that is the record of sulfanilamide in today's warfare against germs. And the end is certainly not yet in sight, for fresh successes are reported in almost every issue of medical journals the world over." These successes include the disease; "puerperal fever, erysipelas, streptococcus meningitis, septic sore throat, septicemia, scarlet fever, gonorrhea, pneumonia, gas gangrene, kidney infections, lymphogranuloma inguinale, undulant fever, choriomeningitis, and brain abscess. The drug is not 100 per cent effective in treating all these diseases but has achieved notable success in curing many of them—far above that of other methods." The substance first to be used for some of these

diseases was Prontosil which "was shoveled around a large German dye works for years before any one suspected its possibilities." The ingredient of this which was really responsible for its effectiveness was found to be sulfanilamide. Recent advances seem to promise its successful use against some filtrable viruses. Heretofore its greatest success has been against illnesses attributable to germs of the coccus group.

—B. C. Hendricks.

ANONYMOUS. "Ocean's Depth Measured by Radio Robot." *Popular Mechanics* 70: 828–830, 130A–131A; December, 1938.

"It's hard to believe that a radio broadcast, an echo and a bomb full of TNT can measure the profile of the ocean's bottom."

The article, of which the above is the opening sentence, tells how it is done. Excellent diagrams.

—O. E. Underhill.

ANONYMOUS. "Lights Turn Battle Against Insect Armies." *Popular Mechanics* 70: 840–843, 118A–119A; December, 1938.

Some of the newer methods of fighting insect pests are described. Light of specific color attracts insects which are then electrocuted. Another type of trap lures the insect into a killing oil bath by directed light rays from mirrors and the use of odorous bait. Details of these types of insect traps are given and specific ways in which they are used are described. Insects so trapped may be used as food for fish, frogs and birds in game farms. There is even a death-dealing infra-red radiator which may be turned on your pet dog or cat to kill the fleas.

—O. E. Underhill.

ANONYMOUS. "The Wonders of Astronomy." *Popular Mechanics* 71: 177–184, 128A–129A; February, 1939.

Largely an account of the new 200 inch telescope and the possibilities for new contributions in astronomy which it will open up. The illustrations and diagrams of the operation of this telescope, with its accessory instruments, are excellent.

—O. E. Underhill.

BROWN, H. M. "Getting Better Pictures with a Candid Camera." *Minicam* 2: 32–34, 93–94; December, 1938.

This article includes simple directions for obtaining better pictures with the minature camera. Margins of the picture, background, middle distance objects, foreground, center of interest, sharp focus, and distance are among many factors needing a checkup before pictures are taken.

—C.M.P.

ANONYMOUS. "Off the 'Platter' Into Your Home." *Popular Mechanics* 70: 882885, 132A; December, 1938.

A description of how the records for electrical transcriptions are made and used in connection with broadcasting. Orphan Annie is heard at 5:45 regardless of the time belt. Such programs are recorded weeks ahead and the records sent to the various broadcasting centers. The wax records from the direct recording are placed in a vacuum chamber and bombarded with gold atoms which produces a gold-plating a millionth-of-an-inch thick. It is then placed in copper sulphate and receives a plating of copper over the gold. This is then reinforced by a heavier copper plating. The wax is then removed and the negative thus resulting is chromium plated. This master record then may be used to form many duplicates.

—O. E. Underhill.

COX, R. C. "Candid Shots in Office, Store or Factory." *The Camera* 57: 396–400; December, 1938.

The article discusses getting the shot, exposure time, film, focusing, film development, and the finished picture.

—C.M.P.

HEBERT, WILLIAM A. J. "Exposure—The Indefinite Quantity." *The Camera* 57: 379–380; December, 1938.

The following four factors are discussed: (1) the speed rating of the film emulsion, (2) the intensity of the light reflected from the objects to be recorded, (3) the size of the iris diaphragm opening in the lens, and (4) the shutter speed of the camera and its accuracy.

—C.M.P.

BUTLER, H. D. "Why Not Ride Your Hobby to Work." *Camera Craft* 46: 24–29; January, 1939.

This is an interesting article on the value and interest found in leisure time photography, especially among friends and associates in business and in social activities.

—C.M.P.

CARTER, HARRIET. "Saving Our Soils." *The Journal of Geography* 37: 308–318; November, 1938.

This is a rather complete unit of study for junior and senior high schools. Major phases of the unit are: (1) the purpose of the study, (2) challenging facts, (3) soil erosion in the school locality, (4) soil erosion in the United States, (5) land treatment to save soil and water, (6) agencies at work saving our soils, (7) suggestions for work, (8) sources for pictures, and (9) bibliography.

—C.M.P.

STAFFORD, JANE. "Ouch! That Toothache." *Science News Letter* 34: 330–333; November 19, 1938.

This article is an interesting summary regarding what is at present known regarding tooth decay and its causes. Pyorrhea and its prevention are discussed at some length.

—C.M.P.

ROUS, PEYTON. "Nature and the Doctor." *Science* 88: 483–489; November 25, 1938.

This article emphasizes the vital need for keen observation on the part of the doctor so as to make better diagnosis of his patient. This skill in trained, analytical observation should apply to all of the doctors activities.

—C.M.P.

HUMPHREYS, W. J. "Why We Seldom See a Lunar Rainbow." *Science* 88: 496–498; November 25, 1938.

The average inland dweller in the United States is fortunate if he sees a lunar rainbow once in a lifetime. This is true for several reasons: (1) the sun is many times brighter than the moon, (2) local or rainbow showers usually occur in the afternoon, (3) the sun may produce a bow everyday and the moon only one-tenth of the days.

—C.M.P.

LYNCH, REV. JOSEPH. "The Earth's Pulse." *Scientific American* 159: 290–292; December, 1938.

This is an excellent, illustrated article on how scientists interpret the signatures of earthquakes as recorded on the moving drum of the seismograph.

—C.M.P.

FAIRCHILD, HERMAN L. "Selenology and Cosmogeology." *Science* 88: 555–562; December 16, 1938.

This excellent article presents the thesis that the basins and pittings of the lunar surface are impact craters caused by meteorites and are ocular confirmation of the view that the planets and satellites were built by cold accretion.

Topics discussed also include hypotheses of planet origin, absence of lunar volcanism, Meteor Crater in Arizona, growth of the earth and beginnings of life on earth.

—C.M.P.

SCIENCE SERVICE STAFF. "Science Advances in 1938." *Science News Letter* 34: 403–416; December 24, 1938.

This issue summarizes the outstanding advances in the various fields of science in 1938.

—C.M.P.

RABEL, GABRIELE. "The Super Microscope." *Discovery* 9: 425–430; December, 1938.

This is an illustrated article on the new invented super-microscope with which magnifications up to the order of 20,000 are attainable. This microscope makes it possible to see the inner structure of bacteria, large colloids and viruses. In the very near future our knowledge of cells, chromosomes, genes, bacteria, and so on, should be greatly enriched.

—C.M.P.

SCHULTZ, C. BERNARD. "The First Americans." *Natural History* 42: 346–356, 378; December, 1938.

Science has rescued the first Americans from oblivion. Revolutionary discoveries in Nebraska and Colorado have pushed back man's known occupation of America at least to 20,000 years ago. Then the early American struggled with climatic conditions radically different from that of today. The Glacial Period ended some 10,000 years ago. Either these early Americans did not survive the climate or they may have migrated southward. Whether or not the Indians were their descendants is not known. These early Americans are called the Folsom people, and preceded the earliest known Indians by several thousand years. They developed a stone artifact different from that of the later Indians.

—C.M.P.

JENKS, GEORGE EDWOOD. "Marvels of Metamorphosis. *The National Geographic Magazine* 74: 807–828; December, 1938.

This excellent article tells how a scientific "G Man" pursued the rare trapdoor spider parasites for three years with a spade and a candid camera. The guilty parasite proved to be the larva of a little-known hunting wasp who lays an egg on the spider's abdomen. The abdomen serves as food for the growing larva. There are 39 splendid photographs.

—C.M.P.

WETMORE, ALEXANDER. "Canaries and Other Cage-Bird Friends." *The National Geographic Magazine* 74: 775–806; December, 1938.

This is the eighteenth article in the National Geographic series on birds. There are 20 illustrations and 51 portraits in color from life by Maj. Allan Brooks.

—C.M.P.

FISHER, CLYDE. "The Romance of Mistletoe." *Natural History* 42: 323–327, 378; December, 1938.

The custom of decorating homes with mistletoe goes back to the ceremonials of the Druids of ancient Gaul and Britain. The Druids bring mistletoe in their huts to lure wood spirits indoors. There are some 500 species of this parasite, growing mostly in tropical and subtropical regions. It grows on a variety of deciduous trees—ash, oak, maple, pecan, cottonwood, hackberry, elm, sycamore, willow, sweet gum, and many others. The seed is spread by birds—robins, cedar waxwings, and mockingbirds.

—C.M.P.

CHERRINGTON, ERNEST, JR. "Astronomy of the Ancients." *Science Digest* 4: 67–69; December, 1938.

This is an article condensed from *The Sky*, a publication of the Hayden Planetarium. To the Egyptians the earth was a flat disc floating upon a vast ocean. This ocean rested upon the backs of several huge elephants which stood patiently upon the broad backs of gigantic turtles. The sun and moon were bowls of celestial fire. The gods brought the sun through a canal beneath the earth back to the east during the night, arriving just in time for the sunrise. During the earlier part of the Christian era the theories of Ptolemy held sway.

—C.M.P.

LEY, WILLY. "The Story of Glass." *Natural History* 43: 13–16, 52–54; January, 1939.

The oldest glass dates back to about 3200 B.C. It was America's first industry, a glass factory being established at Jamestown in 1608. Much progress has been made in glass making, especially in very recent times. However, its chemical structure remains as baffling as its ancient origin.

—C.M.P.

ANONYMOUS. "Versatile Glass." *The Science Leaflet* 12: 562–568; January 12, 1939.

This illustrated article is taken from *The Laboratory*, published by the Fisher Scientific Company. The article presents a brief history of glass making and then discusses some of the recent advances made in glass making. Illustration are very good.

—C.M.P.

ANONYMOUS. "The Overweight Hazard." *Science Digest* 5: 81; January, 1939.

This article is condensed from the *Illinois Medical Journal*. Overweight tends to shorten life. Men who are 35 per cent overweight have a mortality rate 1½ times that of average weight. In specific diseases the hazards of overweight as compared with average weight are as follows: heart disease and cerebral hemorrhage, 1½ times; angina pectoris, 2½ times; and Bright's disease, 1¾ times.

—C.M.P.

GREEVES-CARPENTER, C. F. "Plants by Liquid Culture." *Scientific American* 160: 5–7; January, 1939.

Plant culture in liquid solutions or hydroponics is described in some detail in this article. Three recommended formulas for making nutrient solutions are included. Directions in experimenting for those interested in taking up a new hobby are given. One advantage of hydroponics over soil culture is that conditions may be more closely controlled. Tomatoes, potatoes, melons, beets, carrots, roses, begonias, gladioli and chrysanthemums seem to thrive in nutrient solutions.

—C.M.P.

ANONYMOUS. "The Conquest of the Dead Sea." *Scientific American* 160: 10–12; January, 1938.

This article describes the process of obtaining salts from the Dead Sea—the difficulties involved and how they are being overcome. The percentage of mineral salts in the Dead Sea is not less than 25 per cent. At present the daily output of the plant on the northern margin of the sea is 30,000 tons of potash and 1,200 tons of bromine annually. It is estimated that the Dead Sea contains more than a billion tons of potash and nearly that much bromine plus many other salts—sufficient to supply the world's present needs for 2,000 years.

—C.M.P.

KROGMEN, WILTON MARION. "The Skeleton Talks." *Scientific American* 159: 61–64; August, 1938.

Bones of skeletons give such amazing data as age, race, sex, stature and so on—information of great importance in anthropology, archeology and criminology. —C.M.P.

ANONYMOUS. "Sword Swallower X-rayed." *Popular Science Monthly* 33: 29; August, 1938.

This is an illustrated article showing that certain circus-freaks, such as a sword-swallower and glass-and-tacks eaters, are not fakes but actually swallow the articles mentioned. There are also photographs of a man able to turn his head 180 degrees on his shoulders.

—C.M.P.

MURPHY, ROBERT CUSHMAN. "Birds of the High Seas." *The National Geographic Magazine* 74: 226–253; August 1938.

This is the seventeenth article in the Geographic series, by outstanding authorities, on the bird families of the United States and Canada. There are 36 portraits in color from life by Major Allan Brooks. Albatrosses, petrels, gonnets, man-o' war birds and tropic birds are considered in this article. —C.M.P.

COTT, HUGH B. "Wonder Island of the Amazon Delta." *The National Geographic Magazine* 74: 634–670; November, 1938.

Animal life of Marajo Island at the mouth of the Amazon river is described—tree dwelling animals and strange fishes and birds. There are 30 illustrations. —C.M.P.

ANONYMOUS. "The Advance of the Diesel." *Popular Mechanics.* 69: 826–829, 131A–132A; June, 1938.

With the Diesel becoming constantly lighter in ratio of weight to horsepower, an increase of from 10 to 200 per cent in efficiency, there is promise that Diesel home units may supply power

at low cost, and be independent of power distribution facilities. This article discusses the changes which may be brought about through the development of such a power unit, and is illustrated with excellent diagrams and brief description of how the Diesel engine operates.

—O. E. Underhill.

ANONYMOUS. "Riches From the Air." *Popular Mechanics.* 69: 872–875, 120A–123A; June, 1938.

An excellent article describing methods of nitrogen fixation and the importance of the products.

O. E. Underhill.

BURDICK, H. O., AND WEAVER, D. W. "Microphotography." *Educational Screen.* 17: 184–185; June, 1938.

A detailed account of how an Argus 35mm. and an ordinary adjustable camera (Eastman Recomar 33) may be combined for taking 35mm. microphotographs. Although the title and first part of the text indicate this is for microphotography the device as finally described seems to be rather a copying camera for reducing diagrams, pictures and so on to 35mm. film strip size.

—O. E. Underhill.

ESKRIDGE, T. J. Jr. "Growth in Understanding of Geographic Terms in Grades IV to VII." *The Journal of Geography* 37: 337–344; December, 1938.

This is a summary of a doctoral thesis, Duke University, 1937. Approximately 800 pupils in grades four to seven of the public schools of Greenwood, South Carolina were tested on the meaning of 135 geographic terms. At least six factors condition growth in understanding: (1) and (2) amount and kind of experience, (3) level of geographic attainment, (4) ways in which meanings are verberalized, (5) mental age, and (6) sex. Growth in understanding proceeds through: (1) an increase in the number of different kinds of meanings, (2) an increase of general information, (3) substitution of basic for associated meanings, (4) development of comprehensive meanings, and (5) a reduction of errors of which important types are those due to: (a) confusion of terms having similar sounds, (b) confusion of positions, (c) application of old meanings to new situations, and (d) other causes.

—C.M.P.

ANONYMOUS. "The Airbrush in Photography." *Better Photography* 2: 4–8, 82–84; January, 1939.

The use of the airbrush has had a tremendous increase in usage in recent years. It is the only method by which "color" can be deposited as smoothly as silver. It is being used to produce many photographic effects today—either on the negative or on the print.

—C.M.P.

ANONYMOUS. "Making Stereoscopic Movies." *Better Photography* 2: 23–24, 80–82; January, 1939.

This is part two of a new line of experiments in third dimensional movies—how they are taken and how they are projected. Very interesting motion picture possibilities would seem to lie in this field.

—C.M.P.

BONNER, JAMES. "The Hormones and Vitamins of Plants." *Science Digest* 5: 42–47; February, 1939.

A hormone is essentially a substance produced in one part of an organism, transferred to another part, and there in very small amounts, influences a specific physiological process. The distinction between a hormone and a vitamin is not always distinct. A substance that may be a hormone to one organism may be a vitamin to another. Vitamin C must be supplied to higher animals but it is produced by rats and used by them as a hormone. All higher plants contain a growth hormone called Auxin-A. Ultra violet destroys Auxin-A, accounting partially, at least, for smaller growths of plants at higher altitudes.

—C.M.P.

New Publications

WORKERS OF THE WPA FEDERAL WRITERS' PROJECT IN THE CITY OF NEW YORK. *Who's Who in the Zoo.* Chicago: Albert Whitman and Company, 1938. 211 p. $1.75.

This is a book equally suitable for junior or senior high school students or adults. It is a sight-seeing tour through the modern zoo, showing more than 100 animals in stunning pictures. Brief descriptions explain curious and intriguing habits. One of the most curious is the Duck-billed Platypus, the real Whozzis of the animal world, neither flesh, fish nor fowl. It lays eggs like a bird, feeds its young on milk, is covered with fur, has a bill and webbed feet resembling those of a duck, is equipped with spurs like a game cock, and poisons its enemies exactly as a snake does.

The accuracy of the book has been checked by well-known curators in various zoological institutions in New York City. The reviewer cannot conceive of a boy or girl who would be uninterested in the book—most of them will be thrilled. —C.M.P.

KANE, HENRY B. *The Alphabet of Birds, Bugs and Beasts.* Boston: Houghton Mifflin Company, 1938. 46 p.

This is the best treatment of animal life for very young children the reviewer has seen. Twenty-three full-page photographs from A to W include ant, bat, frog, owl, quail, woodchuck, with X, Y, Z "just letters left over." These photographs in themselves are well worth the book. However the book itself goes far beyond that. Each photograph is accompanied by a clever two line jingle in the traditional alphabet-book manner. Opposite to the photograph is a paragraph of information suitable for being read by older children, or for being read to the child by the parent. These paragraphs present interesting information for the parent's benefit, who, if he be clever will be able to paraphrase it for the young child. The information is correct and has been exceedingly carefully selected to develop points of view. This is a real addition to the nature-study literature for the pre-school child. —O. E. Underhill.

CONRAD, HOWARD L. AND MEISTER, JOSEPH F. *Teaching Procedures in Health Education.* Philadelphia: W. B. Saunders Company, 1938. 160 p. $1.75.

According to the authors this book is primarily intended for training future teachers, particularly those who plan to teach in secondary schools. The importance of lesson planning, selecting subject-matter and the construction of units of instruction are taken up. Examples of several types of lesson plans the authors have found unusually successful are included. Oral questioning, visual aids and testing are emphasized. Biology and general science teachers will also find this book illuminating. —C.M.P.

ANONYMOUS. *Science Booklists for Boys and Girls.* Baltimore: Elsa Clark, Enoch Pratt Free Library. $0.05 each; $0.35 for complete set of fourteen.

The Enoch Pratt Free Library has prepared a series of booklists in various fields of science for boys and girls. The books listed have a brief, but pertinent description of contents. The fourteen following lists have been prepared: (1) *The Wonders of the Natural World,* (2) *Men Who Found Out,* (3) *Exploring With Naturalists,* (4) *The Sky, the Wind, and the Weather,* (5) *The Changing Earth,* (6) *Modern Physics, Chemistry and Electricity,* (7) *Nature's Garden,* (8) *How to Know the Trees and Shrubs,* (9) *Animals and Their Ways,* (10) *Birds of Forest, Field and Stream,* (11) *Wonder World of Insects,* (12) *In the Land and Along the Shore,* (13) *Ancient Man* and (14) *Eyes to See.* —C.M.P.

Gates-Strang Health Knowledge Tests. New York: Bureau of Publications, Teachers College, Columbia University, 1938. $3.15 per 100 for each form; $25.20 per 1000. Sample set 15 cents.

This series is a new revision of these tests, appearing in three forms: A, B, and C for the elementary grades (3–8); D, E, and F, for the advanced grades (7–12). Each test comprises 60 questions of the five-options type, the three forms on each level being closely equal in difficulty thus permitting repeated testing of pupils. Time required for elementary form 40 minutes, for advanced form 30 minutes.

These tests can be used to gain a better understanding of needs of individual pupils, to provide information essential to guidance of pupils, to show progress in health instruction, to indicate areas of instruction needing greater attention, and to measure pupils' knowledges in the health field. —L.M.S.

PEATTIE, DONALD CULROSS. *A Child's Story of the World.* New York: Simon and Schuster, 1937. 140 p.

This is a brief history of civilization from the "first men" to ships, airplanes and telephones. This is a history, however, and does not emphasize science. It is excellently written, of course, and very attractively illustrated by Naomi Averill—A Junior Literary Guild selection. —O. E. Underhill.

PIGMAN, AUGUSTUS. *A Story of Water.* New York: D. Appleton-Century Company, 1938. 151 p. $1.50.

"There are many stories of water. This is the first story of water for men to drink and to cook and bathe with." The first hundred and ten pages is a child's history of the rise of civilization from the cave man to modern times with comment on the methods various peoples had of obtaining and using water. The last of the little book tells of the modern city waterworks. It is good reading for the serious minded child of ten or twelve years. —E.R.D.

PEATTIE, DONALD CULROSS. *A Prairie Grove.* New York: Simon and Schuster, 1938. 289 p. $2.50.

The stage is set on a woodland islanded by the billowing prairies in the land of the Illini. The scenes begin when a Franciscan priest, a French chevalier and voyageurs first contact the Indians. They continue as the sturdy white settlers adventure into the wilderness to lay down their lives for hard-won homes. It is a thrilling tale of Indian life, border warfare, pioneer heroism, love. It is history documented with fifteen pages of bibliography. Only the names are fictitious. For the nature lover its keenest delights are the oft-recurring brilliant descriptions of the teeming life of the prairie and woodland. The naturalist outshines the historian. —E.R.D.

EDGE, ROSALIE. *Our Nation's Forests.* New York, 734 Lexington Ave: Emergency Conservation Committee, 1938. 23 p. $0.10.

Conservation is being very greatly emphasized in elementary—and secondary-school curricula today. There is great demand for materials suitable for classroom use. This is a most useful bulletin divided into the following divisions: (1) Forests A Necessity to Man, (2) The Destruction of Our Nation's Forests, (3) Restoration—How Much Can Be Accomplished? (4) Demands Upon Our Forests, and (5) Forests for the Future.

Previous units in this series are: (1) Shortage of Waterfowl, (2) Hawks, (3) Eagles, (4) Fish-eating Birds, (5) Owls. —C.M.P.

FRY, WALTER AND WHITE, JOHN R. *Big Trees.* California: Stanford University Press, 1938. 126 p. $1.50.

This is a revised edition of a book whose first edition was reprinted three times. In this revision some material has been rewritten and three new chapters have been added. The first edition was considered the best book ever written on the Big Trees, and the enthusiasm, warmth, and scientific appreciation manifest in the earlier edition have not been lost in the revision.

Truly the Big Trees—Sequoia gigantea—are one of the real wonders of the world—found no place except in a few areas in California. While not now considered to be the oldest living thing, the Big Trees are very, very old. By actual ring count the oldest one was 3126 years, although John Muir records that he found one 4,000 years old. Many now living are probably over 3500 years old, could their age be accurately determined. The age limit is unknown, because there is no record of one dying of old age. It is thought that they could probably live for 7000 or 8000 years, or even 10,000 years if protected. The General Sherman is considered the largest of the Big Trees, having a height of 272 feet, a base circumference of 102 feet, 14 feet in diameter 180 feet above the ground and weighing an estimated 2145 tons. The tallest one (a fallen tree) measured 347 feet. While fires and lightning are the worst enemies of the Big Trees, they are remarkably resistant to both.

This is an excellent book for the high-school science book shelf and for all lovers of trees. —C.M.P.

RANDALL, CHARLES E. AND EDGERTON, D. PRISCILLA. *Famous Trees.* Washington, D. C.: United States Department of Agriculture, 1938. 115 p. $0.15.

The low price, excellent illustrations and interesting information ought to mean that anyone interested in trees—biology teachers, general science teachers, elementary science teachers, and others—should own this book. Needless to say, it is an excellent addition to the library science shelf and as a reference book for Conservation courses. Does your state or community have any famous or unusual trees? You may find that answer here! The publication is divided into three parts: (1) Trees Associated with Notable Persons, Events or Places, (2) Trees Notable for Unusual Size or Age, and (3) Freak Trees.

Naturally the Sequoias win the honors as our largest trees—the accolade going to the General Sherman Tree—36½ feet in diameter, a height of 272 feet, and a volume of 600,120 board feet. It is probably 4000 years old. The tallest tree—a redwood near Dyerville, California, is 364 feet high. In 1915 a sycamore at Worthington, Indiana, was adjudged the largest shade tree in the United States, having a circumference of 42¼ feet and a height of 150 feet. Freak trees include the "maple tree growing on a redwood" at Scotia, California, the Prayer-book Pine Tree in California, the Live Oak Table Tree in Florida, the Courthouse Tower tree in Greensburg, Indiana, and the Lyre Tree at Livingston, New Jersey. —C.M.P.

MATHEWS, F. SCHULER. *Familiar Flowers of Field and Garden.* New York: D. Appleton-Century Company, 1937. 310 p. $2.50.

This is the revised edition of a well-known handbook for the identification of flowers. The material is organized in a convenient and useful manner, the flowers being discussed in a most practical way—by the months in which they appear. Means are provided for identification

together with their botanical names, illustrations and many interesting facts and observations.

The author is well-known for his "Familiar Trees and Their Leaves," "Fieldbook of American Wild Flowers," "Fieldbook of Trees and Shrubs," etc.

Biology teachers and elementary science teachers will find this a most useful guide for identification. —C.M.P.

KAMM, MINNIE WATSON. *Old-Time Herbs for Northern Gardens.* Boston: Little, Brown and Company, 1938. 288 p. $3.00.

This is a comprehensive volume on herbs, both familiar and less familiar, found in northern gardens. The author includes the origin, history, appearance, and uses of various herbs. There is a classification list according to their use, an index of common names, and index of latin names, numerous illustrations, and a series of photographs.

The book should be of interest to biology students, biology and elementary science teachers and to the general reader. The kinds of herbs we commonly find in gardens or can be grown in the garden, are listed in this treatise which is non-technical in treatment. It would serve as an excellent general reference on herbs. —C.M.P.

WYLIE, C. C. *Our Starland.* Chicago: Lyons and Carnahan, 1938. 378 p. $0.88.

This is a beginners' easy guide to the study of the heavens. The author is associate professor of Astronomy at the University of Iowa. It is about junior-senior high-school level in difficulty, with a wealth of information unusually well-presented. Elementary science and general science teachers will find it an excellent reference. Few books are so chockful of interesting information. The many pictures, illustrations and star maps make it a most practical book, too. Anyone adding this book to either the library science shelf or to his own private collection will not be disappointed. —C.M.P.

ATYEO, HENRY C. *The Excursion as a Teaching Technique.* New York: Bureau of Publications, 1939. 225 p. $2.35.

This is a doctor's dissertation carried out at Columbia University. The purpose of the study was "to discover, analyze, and in a measure evaluate, various excursion techniques with a view to making available to teachers and administrators information which would enable them to achieve a more effective utilization of the excursion technique."

The method of procedure was a study of excursion techniques in certain European countries and the United States. An analysis of procedures in current use was made. Results obtained by using an excursion technique were measured and compared with those obtained from the use of a different teaching method.

Some conclusions from the study are as follows: (1) The excursion technique is applicable in all departmental fields, and in schools of all sizes; (2) Prevalent usage places practically all administrative responsibility for the excursion in the hands of the teacher; (3) Provision in school budgets for expenses of transportation, the chief item of excursion costs, is essential to the full use of the technique; (4) Suitable preparation for the experiences of the excursion and retrospective emphasis on the highlights are generally accepted as essentials of a successful technique; (5) Minute preparation of all details, and extremely definite direction of pupils' attention are especially important factors in insuring maximum achievement from any excursion; (6) A very wide range of values is claimed for the excursion technique in the literature; and (7) All evidence now available points to the fact that, within the limits of the experiments, the excursion technique is a more valuable adjunct by far to class discussion than are any of the methods which have been studied in comparison with it. —C.M.P.

BENSON, CLARENCE H. *Immensity. God's Greatness Seen in Creation.* Chicago: The Scripture Press, 1937. 140 p.

In this book the author attempts to correlate man's ideas of the universe as found in the Bible with those revealed in astronomy. They are not nearly so antagonistic as many usually assume. Much truth still lies hidden in each field. When the ultimate truth is known in each field, similarities will probably far outweigh the differences. Persons interested in the field of science and religion will greatly enjoy reading this book, even if they disagree with many or all of the conclusions drawn. They likely will not disagree with most positions taken by the author. —C.M.P.

MEYER, JEROME S. *Fun for the Family.* New York: Greenberg Publisher, Inc., 1937. 288 p. $1.95.

Here is a book that most people, old and young, will enjoy. The eight parts are divided as follows: (1) word puzzles and anagrams, (2) fifty brain twisters, (3) test yourself, (4) thirty oral games that require no preparation, (5) thirty pencil and paper games, (6) thirty games of action, (7) games for special occasions, and (8) twenty magic tricks—thirteen stunts—crazy bets. Answers are given in the last part of the book. The "test yourself" group includes: (1) how good a witness are you? (2) how good a detective are you? (3) how good is your memory? (4) how good a D. A. are you? (5) how good is your time sense? (7) how much do you know? —C.M.P.

FUNK, WILFRED J. *So You Think Its New.* New York: Funk and Wagnalls Company, 1937. 198 p. $2.00.

This is a book of surprises. Most people will be astounded when they read it. One's concept

of progress will be greatly revised. Whether money, morals, depression, divorce lawyers, taxis, tooth-powder, it has all been done before. The games we play, the graft of public officials, greed for power and money, vice, corruption, selfishness are very old. Tricks and devices used today are often but slightly changed from what the Greeks and Romans of yesterday did. Yes, even hot-dog stands, permanent waves, lip-stick, nudism, twelve-story apartment houses and many other things so often thought of as modern are really very, very old. The world makes progress but slowly. —C.M.P.

Dana, Margaret. *Behind the Label.* Boston: Little, Brown and Company, 1938. 255 p. $2.00.

The subtitle to this book is a Guide to Intelligent Buying. The author is a merchandizing counselor. She has been designer, manufacturer, and retailer. Her vigorous fight for fair trade has resulted in her repeatedly giving testimony before the Federal Trade Commission. She seems to know many of the tricks of the trade, and thus is able to campaign for the consumer intelligently against trickery, deliberate misinformation and outworn traditions of retail trade. She is especially an authority on textile goods and this book is wholly devoted to that phase of selling.

It is an excellent reference book for Home Economic classes and for any science class discussing textiles. And it is an excellent book for any one—pupil, teacher, or adult who buys and wear fabrics—and this just about includes everyone. The discussion on sizes, rayon, furs and buying is especially good. It is a book of good, sound advice. —C.M.P.

Brindze, Ruth. *Johnny Get Your Money's Worth.* New York: The Vanguard Press, 1938. 230 p. $2.00.

This is a book on buying and consumer education intended especially for boys and girls of junior high-school age. Much interesting information is presented. In 1937, three hundred and forty-seven of the biggest advertisers in this country spent more than 200 million dollars in radio and magazines, plus additional amounts in newspapers, and salaries to radio stars and others. Amounts paid to radio and magazines include more than 9 million by General Motors, nearly 7 million by Procter and Gamble and nearly 5 million by General Foods. Who pays these bills? The consuming public. Is this expense legitimate? Sometimes "yes," often "no." Are articles on "special sale" usually "good" purchases? Usually not. If marked "half price"—what does that mean? Is the merchant losing money? Very rarely does the merchant lose money on any article sold, regardless of what his advertisements say.

This book contains much information and good advice for the juvenile buyer. And shouldn't that be a function of the school—to help boys and girls become more intelligent buyers? Some topic headings are: (1) Getting What You Want, (2) Advertising Marches On, (3) Candy—How to Choose It (See *Time* for December 28), (4) All for Sport, (5) Tests for School Supplies, (6) Chiefly for Girls, (7) Shopping for Clothes, (8) Eat and Grow Strong, (9) To market, to market, and (10) Teamwork for Customers. —C.M.P.

Bent, Silas. *Slaves by the Billion.* New York: Longmans, Green and Company, 1938. 244 p. $2.50.

This is the story of mechanical progress in the home. Homemaking is the world's biggest business, involving a larger financial turnover, and affecting the greatest number of lives. And how different are our homes of today from those of even our grandparents—in so many homes much of the drudgery and long hours of tiring labor have been either wholly or partially eliminated.

In no phase of our life is labor saving machinery more manifest than in the home. We Americans boast of our standards of living, and yet with all our gains, conditions are far below what they could and should be. Our advances have been spasmodic rather than universal. (Read *You Have Seen Their Faces* or *Forty Acres and Steel Mules.*)

Among the many interesting things pointed out by the author: (1) At an outlay of only a dollar a week the average family can now command the equivalent of eleven servants. (2) More slaves in the guise of gas and electricity are created in this country than all history has ever seen in human form, (3) Mechanical inventions offer better food, better health, greater comfort at less costs—resulting in great savings in our most precious asset—human energy, (4) The light we read by and work by is a most important factor in our health—under severe eyestrain we may exert more physical effort than a ditchdigger. (5) Better cooking, a wider variety of food, automatic refrigerators, clothes washers, easier ironing, electric sweepers, attractive colors and furnishings, more comfortable furniture, homemade climate—pleasantly warmed in winter and air-cooled and conditioned in summer, mechanical milkers and cream separators, telephone, radio and newspapers are a few among the many labor saving devices mentioned. But with this desirable change has come one serious problem—that of unemployment. Freeing women from household tasks has enabled them to enter industry in competition with men—with the result that we have had a steady gain in the number of women employed despite the depression—the only loss in jobs have been those of men. We must solve this problem somehow, for who would want to go back to the good old days not even the advocates of this device could be persuaded for one instant to give it a few-years' try.

This is one of the finest references for science teachers and secondary school pupils. No better insight could be gained into what science means in our homes and daily lives, than by reading this book. —C.M.P.

PALMER, DEWEY H. AND CROOKS, LAURENCE E. *Millions on Wheels.* New York: The Vanguard Pres, 1938. 308 p. $2.50.

This book is a new approach to the problem of automobiles—how can the purchaser and user get the most for his money. Undoubtedly the book will prove a great saver of money to many automobile drivers who read it. Some problems discussed and answered, (answered as honestly as they can be answered for the authors are not employed by any motor corporation, oil company or rubber tire manufacturer) are as follows: Is it necessary usually to change oil every thousand miles? What tires cost least per thousand miles of service? How can money be saved on gasoline and oil? What car is most preferable in each price range? How do we select a used car so as not to be "gypped"? How can we reduce repair bills? What about accessories and supplies?

The reviewer could answer these questions, but will let the reader have the fun of finding out.

A supplement gives ratings on 1938 models, tires, gasolines, batteries and so on, and Supplement No. 2 rates the 1939 models. Makes are named in all instances.

This is an excellent book for the high school science shelf, for the science teacher and for any car driver. Much scientific information is included. —C.M.P.

WELDEY, ROY A. *Your Automobile and You.* New York: Henry Holt and Company, 1938. 251 p. $0.88.

This is a textbook based on a course in automobile driving offered in the Scott High School, Toledo, Ohio. It is one of the most timely books published in recent times. The author believes the freshman year is none too early to have a course in automobile driving. The text is intended primarily for the use of high-school pupils who are just beginning to learn the art of driving. There are complete instructions for those who have never driven a car before. An outline of 56 lessons based on the text are included. Among the topics included are: (1) The story of the automobile, (2) X-Ray of an automobile, (3) Care and feeding, (4) Physical fitness of the driver, (5) Automobile physics, (6) The psychology of driving, (7) The school of the driver, (8) Customs and rules of the highways, (9) Traffic laws, (10) Automobile insurance, (11) Automobile accidents, (12) Buying an automobile, (13) Highways, (14) When driving becomes an art.

This is a splendid reference book for general science courses, physics courses, and courses in safety and conversation. —C.M.P.

NIXON, HERMAN CLARENCE. *Forty Acres and Steel Mules.* Chapel Hill, N. C.: The University of North Carolina Press, 1938. 98 p. $2.50.

Science teachers are, or should be, as vitally concerned with social conditions as any other teaching group. Science through education can do more than any other agency to alleviate suffering and hardship and bring under-privileged peoples up to more desirable standards of living. That we have a long way to go before all Americans reach what we could reasonably call a decent standard of living is evident when we read such book as *Forty Acres and Steel Mules, You Have Seen Their Faces* or *90° in the Shade.* Science teachers and leaders should read such books as these for it will make them ponder seriously what science should be taught and how, to a great mass of our pupils. If we're not presenting them a functional science, how can we make it functional for them?

This is an interesting, penetrating analysis and interpretation of the rural South. The author writes with the intimate knowledge of one who lived on an Alabama upland plantation during boyhood, was educated in two southern colleges and has since taught in four southern institutions of higher learning. He describes this book as "a hillbilly's view of the South." The South has more share tenants and croppers and poorer tenants than any other farming section of the country. The white group is in the majority. Farming has been of the one crop-type—cotton. Both the soil and its people have been grievously exploited. The source of power has been "one-mule power" and the number of acres usually about forty. With the coming of steel mules (tractors and other farm machinery) forty acres are not enough. Thus the plight of the small tenant farmer is becoming worse and worse. What can be done about it? Dr. Nixon says the South must plan for social action or resign itself to poverty and disintegration. The problem is a difficult one, and it can be solved, but will it be solved? Several suggested procedures are pointed out, but the difficulties are great. As the author suggests, poverty and ignorance go hand in hand, and the only solution in the long run, is education.

An excellent series of pictures makes the condition described far more vivid and realistic. —C.M.P.

FAIRCHILD, DAVID. *The World Was My Garden.* New York: Charles Scribner's Sons, 1938. 494 p. $3.75.

David Fairchild, the author of this book, has long been one of the highly esteemed biologists of the world. Stepping into an experiment station anywhere, he would probably be immediately addressed with his correct name by one or more of the scientific workers whether the meeting occurred in Java or Manhattan, Kansas, or anywhere between on either side of the earth. He has been almost everywhere, to the hinterlands of ancient civilizations and to all the places

where organized groups are endeavoring to apply biological science to improvement of crops and of man himself. The book is far more than an autobiography of a life-long traveller. It is a graphic picture of the first half century of development of foreign plant introduction into American farms, gardens and landscapes.

The author, like many other eminent scientists, got his start at the Kansas Agricultural College. Then, after short periods at Rutgers and the United States Department of Agriculture, he joined the group of young Americans studying at Naples and various places in Germany. When almost ready for his doctorate, a wealthy travel-acquaintance, met earlier on his first water voyage, provided Fairchild with funds for his long desired sojourn in Java. This was the beginning of many journeys, sometimes alone, sometimes with his sponsor. The object always was to find plants which might prove useful in the United States. The sponsor, Mr. Lathrop, not only provided funds, but often suggested the specific objective of a trip, but he always preferred far-away and difficult places. The readiness and abandon with which he and Fairchild would suddenly decide, pack, and start to some remote region could not avoid shocking their more firmly-anchored friends. The quantity of plants sent to the United States Department of Agriculture for experimental growth and trial, kept the facilities for experiment always crowded. The copious accurate field and historical notes and well-made photographs provided the basis for scientific study of the economic and decorative plants that were shipped home. These introduced plants are now grown throughout the country, wherever they will prosper and wherever people can be educated to use new food plants.

Like all discriminating travellers, the author makes no end of comments about life of humans as well as of plants and animals. When beginning to recover from typhoid in the depths of India, he was shipped almost as baggage to a seaport town. He calmly remarks: "The moon was rising over the hills when Mr. Lathrop met me at the station. I thought that I had never seen anything so beautiful, but to Mr. Lathrop it did not appear different from any other moon which he had seen. The newness of even commonplace things after a severe illness is compensation of a sort for the suffering and discomfort of the disease. It is an indictment of our poor use of our imaginations when we are well, that we lose the thrill of living, and allow the charm of little things to escape us."

Then, in Egypt, after receiving messages about deaths of relatives and friends he says: "Anyhow, I had no alternative but to push on. Life is nothing but pushing on, after all."

When Spanish almonds grown from trees he had introduced into California failed to possess the desired quality, he stated this conclusion concerning heredity and environment. "As no two spots on the earth's surface have identical soil and climatic conditions, the hope of absolutely duplicating a fruit grown in one locality by growing the same variety in another is a futile one."

And illustrating a common lack of practical ability even by persons engaged in practical jobs, he describes his difficulties in attempting to plant his own garden: "When I started to create my own home, I soon discovered that through all my years of association with professors of horticulture, agricultural colleges, and experiment stations, I had developed a blind spot toward the practical formulae of such an immensely simple thing as the making of a flower or vegetable garden."

The style of writing may be called anecdotal. That is, the author moves along from one occurrence to another, with engagingly simple description. Uninteresting and unessential details are omitted; and included are all sorts of human experiences that are involved in effective dealing with unfriendly or uninformed people. The difficulties in the development of the United States Department of Agriculture are mentioned almost casually, though it is well known that the days of adjustment were sometimes strenuous. Withal, the whole story is unique. There cannot be another like it, because there was but one David Fairchild during that stage in the development of applied biology in which foreign economic plants were so abundantly introduced in America.

—Otis W. Caldwell.

ARNOLD, OREN. Wild Americans. Chicago: Albert Whitman and Company, 1937. 159 p. $1.50.

This is a series of 22 short stories about wild animals which are encountered by the Blair family during their journey through the West and the Southwest with their car and trailer. The experiences of Virginia and Buck, the two children in the party, provide action throughout the book, and make interesting and natural means of giving vital information about the various animals. The book is well illustrated. Very young children enjoy having the stories read to them; for grade use the book would be adaptable from third grade to seventh.

—L.M.S.

KENLY, JULIE CLOSSON. *Little Lives.* New York: D. Appleton-Century Company, Inc., 1938. 271 p. $2.50.

This is a popularized story of the world of insects and spiders which will interest grades above the fifth. It contains much factual material about insects in general, as well as of specific insects and important spiders. It holds the attention. The book is sparsely illustrated with sketches on black and white.

—L.M.S.

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